RADIOLOGY

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RADIOLOGY

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Vol. 60 MAY 1953 No. 5

Roentgenographic Appearance of Metastases to the Central Lymph Nodes of the Superior Mesenteric Artery in Carcinoma of the Right Colon[1]

JAMES J. McCORT, M.D.

Boston, Mass.

CARCINOMA of the colon may spread to contiguous tissue by three main routes: by peritoneal seeding; by venous thrombi entering the portal system and lodging in the liver; and by lymphatic emboli or permeation. It has been found that intramural penetration precedes lymphatic dissemination (4); extramural spread is usually associated with lymphatic spread and is evidenced by fixation of the primary tumor to adjacent structures (15). That lymphatic dissemination is the most common method of metastasis is attested by many studies (1, 3, 4). Jamieson and Dobson (10) and later Coller, Kay, and MacIntyre (4) elaborated the function of the lymphatic system in the spread of carcinoma of the colon, and their findings prompted a more radical type of operation. At the present time the treatment of choice demands the resection of the primary lesion together with all the accessible lymph nodes in the drainage pathway. The extent of the resection is limited only by the necessity for preserving the vascular supply of the remaining segments of the large and small bowel. In a series reported by Allen, Donaldson and Welch (1), it was also necessary in approximately one-third of the cases to resect adherent adjacent structures together with the primary tumor. When metastases are present in the lymph nodes at the time of operation, the opportunity for five-year survival is reduced by approximately 50 per cent (3, 7, 16).

Lymph nodes that are the site of metastases tend to undergo enlargement. Enlarged nodes, however, do not invariably indicate metastases, while unenlarged lymph nodes may be the site of small-tumor emboli. Marked enlargement of the intra-abdominal nodes is necessary before they can be detected by external palpation. Their roentgenographic detection is possible only when they impinge upon or deform a hollow viscus which can be opacified, such as the gastric fundus (12) or the ureter (2). The tertiary lymph nodes in the drainage pathway of the right side of the colon lie in close approximation to the retroperitoneally placed third and fourth portions of the duodenum, and by recognizing enlargement of these nodes it may be possible to determine the extent of a right colonic cancer preoperatively or, following operation, to detect recurrence in the lymph nodes. This study attempts to dem-

[1] From the Department of Radiology, Massachusetts General Hospital, Boston 14, Mass. Accepted for publication in July 1952.

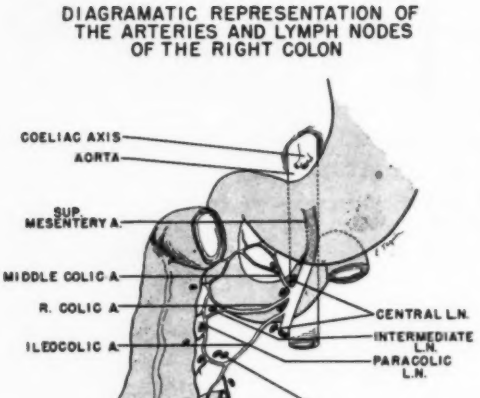

Fig. 1. Relationship of arteries and lymph nodes to the third and fourth portions of the duodenum.

onstrate the roentgenographic appearance of such metastatic nodes.

ANATOMY

The right side of the colon (the cecum and appendix, the ascending colon, and the right two-thirds of the transverse colon) derives its blood from the superior mesenteric artery, which also supplies the entire length of the small intestine, with the exception of the proximal portion of the duodenum. This artery arises from the anterior surface of the abdominal aorta just below the celiac axis. Proximally it lies behind the pancreas, passing forward and downward to emerge between the pancreas and the upper border of the third portion of the duodenum. At this point it enters the mesentery and traverses this structure, gradually curving to the right (9). The superior mesenteric artery has five major branches: (*a*) the inferior pancreaticoduodenal; (*b*) the intestinal branches; (*c*) the ileocolic artery; (*d*) the right colic artery; (*e*) the middle colic artery (Fig. 1).

The lymphatic vessels draining the right side of the colon parallel the arterial supply (5, 10, 11). The submucosal network of collecting vessels passes to the surface of the bowel in the direction of the mesocolic border. In the pathway of these vessels and situated on the surface of the bowel are small epicolic lymph nodes. Arriving at the mesocolic border, the lymph from the colon enters the paracolic nodes which are situated in the arches of the paracolic arteries (5, 10, 13) (Fig. 1). Collecting vessels from the cecum and appendix pass to the ileocolic lymph nodes. The paracolic and ileocolic nodes form the so-called *peripheral group* of mesenteric lymph nodes.

The *intermediate lymph nodes* are placed midway in the mesentery at the divisions of the major branches of the superior mesenteric artery. They receive lymph from the peripheral group *via* collecting vessels which parallel the arteries.

The *central lymph nodes* are located in the mesentery at the site of the origin of the major branches of the superior mesenteric artery. From these nodes lymph usually flows through the intestinal lymphatic trunk to join the left lumbar lymphatic trunk, which combines with the right lumbar trunk to form the thoracic duct. A number of common variations are described by Rouvière (13). It is the central group of mesenteric lymph nodes that lies in close approximation to the third and fourth portions of the duodenum at the site of crossing of the superior mesenteric artery.

MATERIAL AND RESULTS OF STUDY

The material upon which the present study is based is composed of 110 cases of carcinoma arising in the right side of the colon treated at the Massachusetts General Hospital during the period Jan. 1, 1944, to Jan. 1, 1952. Of this number, 105 came to operation, and resection of the primary tumor and the associated lymph nodes was carried out in 87. According to the surgeon's note, 24 of the group (27.5 per cent) had palpable evidence of lymph-node metastases. Routine histological examination of the resected nodes showed metastases to be present in 32 (36.8 per cent).

Determination of the true incidence of

lymph-node metastases requires a very painstaking and time-consuming search by the pathologist, which is seldom practical in the routine work of a large hospital. Coller and his co-workers (4), in a thorough study of 46 specimens of carcinoma of the colon, isolated an average of 52 lymph nodes per specimen. When these nodes were examined microscopically and charted on diagrams 60.87 per cent were found to contain metastases. Grinnell (8), in a similar investigation, found lymph-node metastases in 43 per cent of the specimens of carcinoma of the colon and rectosigmoid which he examined. The disease had spread only to the epicolic and paracolic nodes in 25 per cent; it had reached the intermediate nodes in 18 per cent. The frequency of spread by collateral channels was also studied by Grinnell; he found evidence of such spread in 7 per cent of colon specimens.

Analysis of the present series failed to indicate any correlation between the location of the primary lesion in the right colon—that is, whether the cecum, ascending colon, hepatic flexure, or right transverse colon—and the presence or absence of lymph-node metastases. Nor was there any correlation between the gross size of the lesion and the occurrence of lymph-node metastases. A small carcinoma of the colon may be associated with extensive lymphatic spread, an observation in accord with the experience of Coller, Kay, and MacIntyre (4) and Craig and MacCarty (5). The grade of malignancy, however, appeared to have some bearing on the frequency of lymph-node metastases. This fact is in agreement with the conclusion arrived at by Simpson and Mayo (14) that the higher the histologic grade of malignancy the deeper the mural penetration and the greater the likelihood of lymph-node involvement.

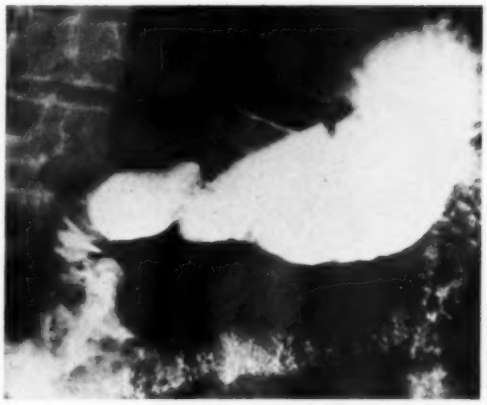

Fig. 2. Enlargement of the central lymph nodes of the superior mesenteric artery by carcinoma.

A 40-year-old white male was admitted with a history of weakness, fatigue, and weight loss of four months duration. Roentgen examination of the upper gastrointestinal tract showed a normal stomach. The *prone right anterior oblique roentgenogram* shows a fistulous tract communicating with the second portion of the duodenum and the hepatic flexure of the colon. An irregular pressure defect (arrows) is seen on the superior margin of the third portion of the duodenum.

Operation disclosed the presence of carcinoma of the hepatic flexure of the colon with extension into the duodenum. The neoplastic tissue was grossly penetrating, so that it was necessary to remove the greater portion of the duodenum along with the tumor. Enlarged, hard lymph nodes were felt at the base of the mesocolon as well as at the head of the pancreas.

The patient returned to the hospital within six months in a terminal stage and died shortly thereafter. Autopsy revealed recurrence of a colloid carcinoma of the colon with extensive intra-abdominal lymph-node metastases, as well as metastases to the lungs and liver.

ROENTGEN DIAGNOSIS

A. The *peripheral group of nodes* (the epicolic, paracolic, and ileocolic) is usually closely associated with the primary tumor and has not been demonstrated with certainty. In a few instances, downward displacement of the terminal segment of the ileum has suggested enlargement of the ileocolic nodes. The position of the ileum varies, however, and this has not proved to be a reliable sign.

B. The *intermediate group of nodes* has not been identified.

C. The *central group of nodes* is susceptible to identification because of close proximity to the third portion of the duodenum at the point where it is crossed by the superior mesenteric artery.

Demonstration of pressure on the duodenum is dependent on rendering this structure opaque by barium or some other contrast substance. When a carcinoma of the colon has been found, examination of the duodenum by barium is contraindicated

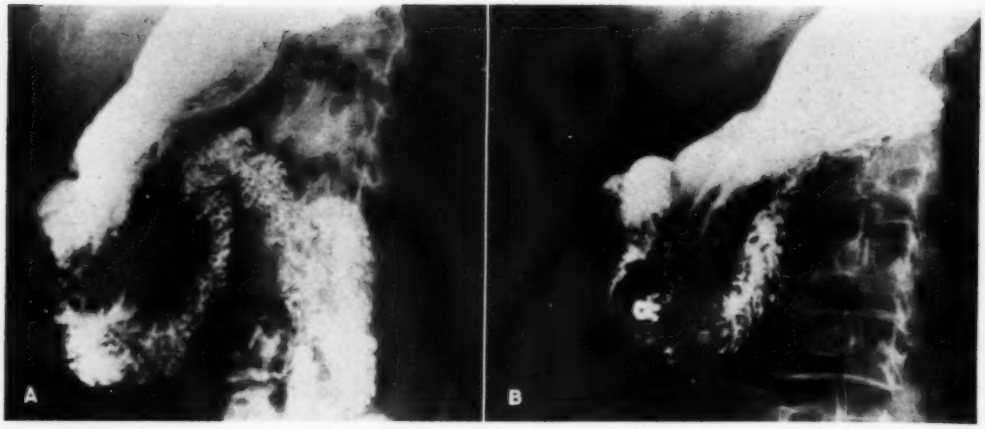

Fig. 3. Recurrent carcinoma in the central lymph nodes of the superior mesenteric artery eighteen months after removal of a primary carcinoma of the cecum.

A 57-year-old white female was admitted in May 1949, complaining of abdominal cramps and frequent bowel movements containing flecks of red blood. Roentgen examination revealed an infiltrating lesion of the cecum.

At *operation* a carcinoma of the cecum was found and the entire right colon with its associated lymph nodes was resected. *Histologic study* of the specimen showed adenocarcinoma, Grade III, with metastases to 2 of 13 lymph nodes examined. The lesion measured 4 × 8 cm.

The patient was well until March 1952, at which time she was found to have a palpable mass, approximately 6 × 6 cm., beneath the mid-point of the transverse colon. This mass was firm, non-tender, and fixed. The liver was not palpated and there were no other masses. *Roentgen examination* of the colon showed the anastomosis to be patent, with no evidence of recurrence at the anastomotic site. A. The upper *gastrointestinal* tract (right posterior oblique projection) shows a pressure defect of the third portion of the duodenum (arrows).

Exploratory laparotomy disclosed that the abdominal mass consisted of metastatic lymph nodes extending along the upper portion of the superior mesenteric artery to its origin. A loop of small bowel had been invaded in its lower extent by the node metastases. A positive lymph-node biopsy was obtained and an enteroenterostomy was performed as a palliative measure. Metal clips, placed at the superior and inferior margins of the mass of lymph-node metastases, are shown in B (arrows). The "R" had been placed on the patient's skin at the site of the palpated mass.

because of the danger of barium impaction at the site of the primary lesion. An attempt to carry out the examination by means of air insufflation *via* a duodenal tube did not prove satisfactory. In one patient in the group, examination of the upper intestinal tract was performed by mistake (Fig. 2), and in this case it was possible to demonstrate a pressure defect in the duodenum.

Because it is not feasible to resect all of the central nodes *en bloc*, those left intact may become the site of recurrent tumor some time after the original operation. Under such circumstances, a mass may be palpated in the midabdomen and clinical signs of duodenal compression may be evident. A barium examination of the duodenum will show a nodular compression (Fig. 3) or actual invasion of the duodenal wall (Fig. 4) at the site of the crossing of the superior mesenteric artery.

Roentgen Technic: Experience has shown that the supine position best demonstrates enlargement of the central nodes, as in this position they lie against the duodenum. Roentgenograms are obtained in both the right and left posterior oblique projections, the latter being the more valuable.

In the case of recurrence of colonic carcinoma in the lymph nodes of the superior mesenteric artery, the decision as to treatment arises. Surgical exploration is probably indicated in the majority of cases: (*a*) to confirm the diagnosis and (*b*) to relieve the duodenal obstruction if present or to forestall possible future obstruction by gastrojejunostomy.

SUMMARY

1. The lymphatic drainage of the right side of the colon parallels the arterial supply which is furnished by the superior mesenteric artery and its major branches.

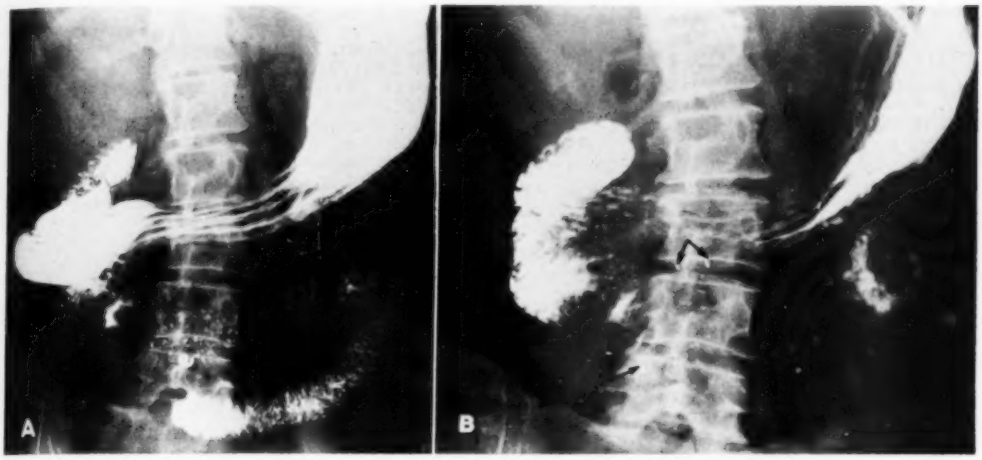

Fig. 4. Recurrence of carcinoma in the central nodes of the superior mesenteric artery three years after resection of the primary tumor in the ascending colon.

A 60-year-old white female was admitted in March 1947 with crampy abdominal pain and clinical evidence of intestinal obstruction. *Operation* disclosed carcinoma of the ascending colon. A right colectomy with primary anastomosis was performed. *Histologic study* of the resected specimen revealed adenocarcinoma, Grade III, 3 cm. in length, with extension to the pericolic fat.

The patient was well until November 1951, at which time she was found to have a small, hard nodular mass in the epigastrium which did not descend with inspiration. *Roentgen examination* of the colon showed the anastomosis to be patent, with no evidence of recurrence at the anastomotic site. An *upper gastrointestinal series* (A) with a lead marker "9" placed on the skin at the location of the palpable tumor shows the mass compressing and invading the third portion of the duodenum (arrows) at the point of crossing of the superior mesenteric artery.

Operation revealed the tumor, containing lymph nodes, at the root of the right colic vessels and surrounding the stump of the superior mesenteric artery. A biopsy was taken from this mass, and metal clips were inserted (arrows), two at its superior margins and two at its inferior margins (B). A palliative gastrojejunostomy was performed. *Histologically* the biopsy specimen was composed of lymph nodes containing adenocarcinoma, Grade III.

2. In carcinoma of the colon, the chief method of spread is by lymphatic embolization or permeation.

3. The presence or absence of lymph-node metastases shows no direct statistical correlation with the site or the size of the primary tumor. Higher grades of malignancy of the tumor are associated with a slightly higher incidence of lymph-node metastases.

4. Of the three groups of lymph nodes in the drainage pathway of the right side of the colon, only the central nodes of the superior mesenteric artery, when enlarged, may be detected roentgenographically. This is possible because these nodes are clustered about the artery at the point where it crosses the third portion of the duodenum and may press upon or invade it.

5. Practical considerations make it impossible to examine the duodenum routinely prior to operation for carcinoma of the colon. It is not possible, therefore, to make a preoperative roentgen diagnosis of lymph-node enlargement.

6. Recurrent carcinoma arising in the central nodes of the superior mesenteric artery may deform and invade the third portion of the duodenum and in most cases their presence can be determined roentgenographically.

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SUMARIO

Aspecto Radiográfico de las Metástasis del Carcinoma del Lado Derecho del Colon en los Ganglios Linfáticos Centrales de la Arteria Mesentérica Superior

El carcinoma del colon puede propagarse al tejido contiguo por tres vías principales: por implante peritoneal, por trombos venosos que penetran en la circulación portal y se alojan en el hígado y por embolización o penetración linfática. Se ha descubierto que la penetración intraparietal precede a la diseminación linfática; la propagación extraparietal suele estar asociada con la propagación linfática, manifestándola la fijación del tumor primario a los tejidos adyacentes. Muchos estudios demuestran que la diseminación linfática es la forma más común de las metástasis.

La circulación linfática del lado derecho del colon paralela el riego arterial proporcionado por la arteria mesentérica superior y sus ramas principales.

En el carcinoma del colon, la principal forma de propagación es por embolización o penetración linfática.

La presencia o ausencia de metástasis ganglionares no guarda correlación estadística directa ni con el asiento ni con el tamaño del tumor primario. La malignidad mayor sí va unida a una incidencia ligeramente más alta de dichas metástasis.

De los tres grupos de ganglios linfáticos en la vía de drenaje del lado derecho del colon, los únicos que pueden descubrirse roentgenográficamente son los ganglios centrales de la arteria mesentérica superior, cuando están hipertrofiados. Esto es posible por estar aglomerados dichos ganglios alrededor de la arteria donde ésta cruza la tercera porción del duodeno, pudiendo comprimirla o invadirla.

Ciertos factores prácticos impiden examinar el duodeno sistemáticamente antes de operar por carcinoma colónico, por lo cual no resulta posible hacer un diagnóstico roentgenológico preoperatorio de hipertrofia de los ganglios linfáticos en dicha región.

El carcinoma recurrente originado en los ganglios centrales de la arteria mesentérica superior puede deformar e invadir la tercera porción del duodeno y en la mayor parte de los casos puede determinarse radiográficamente la presencia de aquéllos.

The X-Ray Appearance and Incidence of Calcified Nodules on the Habenular Commissure[1]

C. G. SMITH, M.D.

THE SHADOW CAST by a calcified pineal gland in a roentgenogram of the lateral aspect of the head is commonly in two parts—a large posterior part and a small cap-like anterior part (Figs. 4, 5, and 6). The cap-like anterior portion is a supplementary opacity which is contributed by calcified nodules of neuroglia located on the habenular commissure. These nodules were observed and described by Quercy, de Lachaud, and Durand in 1938. The present study was undertaken to obtain further information concerning these nodules which might be of value to the radiologist.

MATERIAL AND METHOD

The brains of 123 individuals, 75 males and 48 females, all free of intracranial disease and ranging in age from twenty to eighty-two years, were obtained at autopsy and fixed in 10 per cent formaldehyde for several months. The cerebral hemispheres, the meninges, and the roof of the third ventricle were then removed to permit inspection of the pineal gland and the lining of the third ventricle. Each gland and the whole habenular commissure, to which it is attached, was then removed from the brain in one piece and roentgenograms were obtained from both the lateral and the superior aspects.

OBSERVATIONS

Structure, Location and X-Ray Appearance of the Nodules: The neurogliar nodules, as described by Quercy, de Lachaud, and Durand, are formed by a localized thickening of the neuroglia between the commissure and the overlying ependyma. These masses of neuroglia attain a thickness of 1 mm. and cover an irregularly shaped area 5 mm. or less across. Several such nodules may be present when they

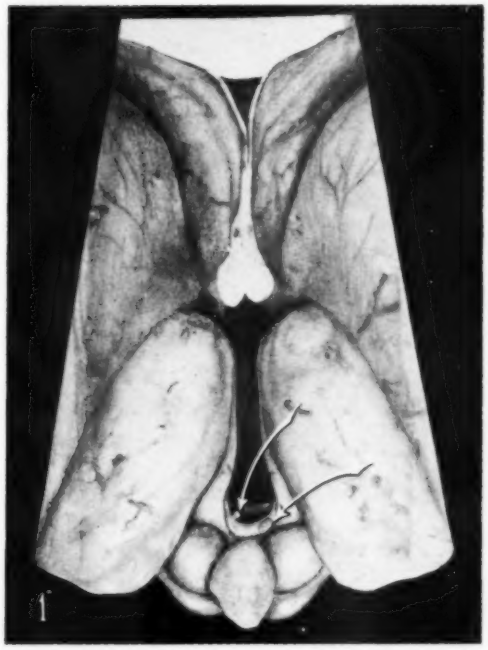

Fig. 1. The dorsal aspect of a forebrain with the roof of the third ventricle removed to show two small nodules on the habenular commissure.

are small, but as they enlarge they unite and form a single large nodule which may cover the whole ventricular surface of the habenular commissure. In the present study of 123 brains, these nodules were found only on the habenular commissure. No anatomical peculiarity of this site was observed to account for this.

The histologic picture of calcification in the neurogliar nodules is similar to that in the pineal gland proper. In both instances, in hematoxylin and eosin stained sections, purple granules are present in the spaces between the neurogliar fibers, and in heavily calcified regions these are large and crowded together into large mulberry-like masses.

Figure 1 is a photograph of the dor-

[1] From the Department of Anatomy, University of Toronto, Toronto, Canada. Accepted for publication in June 1952.

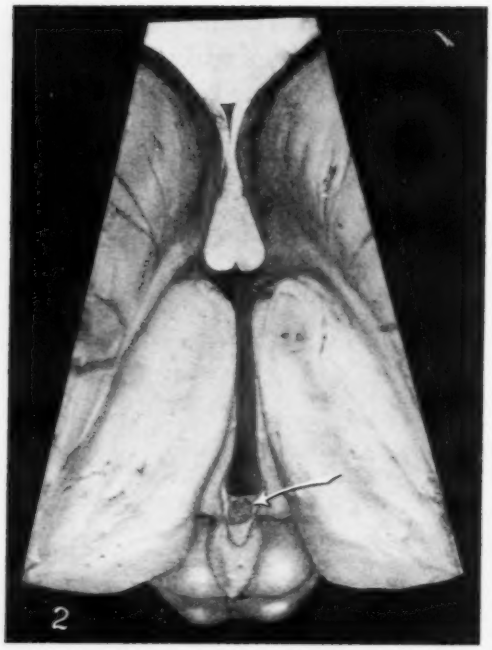

Fig. 2. The dorsal aspect of a forebrain with the roof of the third ventricle removed to show one large nodule which covers most of the habenular commissure.

sal aspect of the forebrain of a specimen with the roof of the third ventricle removed to show two small nodules on the habenular commissure. Figure 2 is a similar preparation in which there is a single large nodule that covers the greater part of the habenular commissure. Figure 3 is a mid-sagittal section to show the thickness and the extent of such a nodule in the median plane. The pineal recess, the extension of the third ventricle into the stalk of the pineal gland, has the habenular commissure in its upper wall and the posterior commissure in its lower wall. The crust-like mass can be seen to cover not only the superior surface of the habenular commissure but its anterior border and inferior surface as well. It extends into the pineal recess as far as its apex. In no case were nodules found on the posterior commissure. Figure 3 also illustrates how the new growth is molded around the anterior border of the commissure to acquire a crescent-shaped profile. Such a nodule, when calcified, will produce a crescentic opacity located at the anterior end of the shadow cast by the pineal gland as illustrated in Figure 4. If the nodule is small, that is, does not cover all the commissure in the sagittal plane, its shadow will look more like a nodule than a crescent, but it will still have

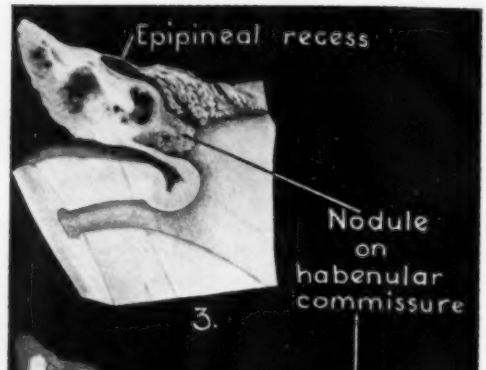

Fig. 3. A mid-sagittal section of a pineal gland and the adjacent parts of the brain to show the thickness and the extent of a large neurogliar nodule on the habenular commissure.

Fig. 4. A roentgenogram of the specimen in Fig. 3, showing the appearance of a large calcified nodule in a lateral view.

its characteristic concave posterior surface (Fig. 5). The clear space between the opacities due to the nodule and pineal gland proper is the site of the habenular commissure and is seen not only in profile but also in a roentgenogram taken from above (Fig. 6). This bundle of commissural fibers does not become calcified even when it is sandwiched between a heavily calcified nodule and a heavily calcified gland.

Incidence: Macroscopic nodules, 1 mm. or more in size, were present in 82 per cent of the 75 males and in 49 per cent of the 48 females examined. They are obviously

very common in both sexes but have a higher incidence in males. The incidence is high even in younger adults. In a group of 10 males, twenty to forty years of age, 8 had large nodules.

Calcified nodules, visible in a roentgenogram, were present in 25, or 33 per cent, of the 75 males, and in 14, or 29 per cent, of the 48 females. In no case was a calcified nodule seen without calcification in the gland proper. In the present series the pineal gland was calcified in 52 (69 per cent) of the males and in 23 (48 per cent) of the females. These results compare favorably with those obtained by Dyke for a comparable age group in a study of a large series of routine head films. In his series 64 per cent of the males and 55 per cent of the females had calcified pineal glands. Our results indicate that the technic used in this study permits the visualization of calcification in the pineal gland with a facility comparable to that in routine head films. Thus, it is of interest to know the incidence of calcified nodules in the roentgenograms of individuals with a calcified pineal gland. In the roentgenograms of the present investigation, 25 of the 52 males with calcified pineal glands and 14 of the 23 females with calcified pineal glands had calcified nodules as well. Thus, approximately one-half of the glands that can be visualized in routine head films may be expected to have a supplementary cap-like shadow which is contributed by calcified nodules on the habenular commissure.

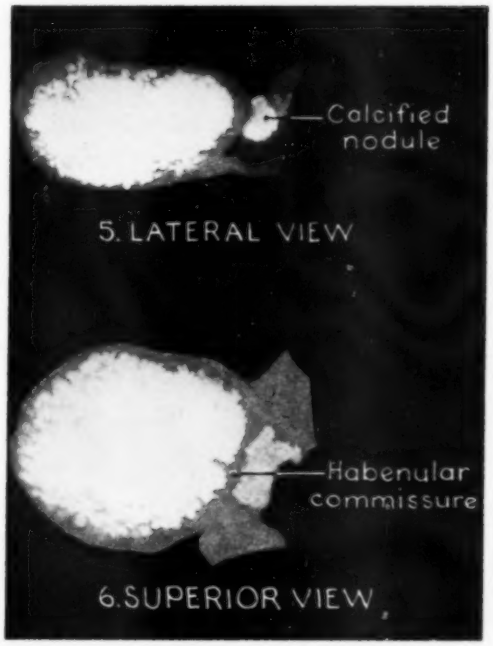

Fig. 5. A lateral roentgenogram of a pineal gland and its associated habenular commissure showing the roentgen appearance of a calcified neurogliar nodule which covers only a part of the habenular commissure.

Fig. 6. A superior roentgenogram of the specimen shown in Fig. 5.

SUMMARY

A calcified nodule on the habenular commissure is seen in the roentgenogram of a pineal gland as a cap-like opacity at its anterior pole. This cap-like opacity as it appears roentgenologically in the lateral view is crescent-shaped, with its concavity facing backward. The crescent may form half a circle if the nodule covers the whole ependymal surface of the habenular commissure. These nodules, in the present study of 123 brains, were recognizable in the roentgenograms of one-half of the calcified pineal glands. This is true for both sexes. In no case was a calcified nodule seen without an associated calcification of the pineal gland. Incidence does not vary significantly with age in individuals over twenty.

ACKNOWLEDGMENTS: The author wishes to thank Dr. D. G. Wollin of the Department of Radiology, University of Toronto, for his valuable help so generously given. The author is also indebted to Mr. C. E. Storton for his technical assistance and to Miss Nancy Joy for so kindly assisting with the illustrations.

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(Para el sumario en espanñol, véase la página siguiente.)

SUMARIO

El Aspecto Roentgenológico y la Incidencia de Nódulos Calcificados sobre la Comisura Habenular

Un nódulo calcificado sobre la comisura habenular aparece en la radiografía de la glándula pineal como una opacidad pileiforme en su polo anterior. Esa opacidad, que se parece a un capucho o gorro en la radiografía, en la vista lateral es meniscoidea, con la concavidad dando hacia atrás. El menisco puede formar medio círculo si el nódulo cubre toda la cara ependimaria de la comisura habenular. En el estudio actual de 123 cerebros, esos nódulos pudieron ser reconocidos en las radiografías de la mitad de las glándulas pineales calcificadas. En ningún caso se observó un nódulo calcificado sin calcificación concomitante del cuerpo pineal. La incidencia no varía mayor cosa con la edad en los sujetos de más de veinte años.

Accidental Visualization of the Ventricles Months After the Intracranial Injection of Thorotrast[1]

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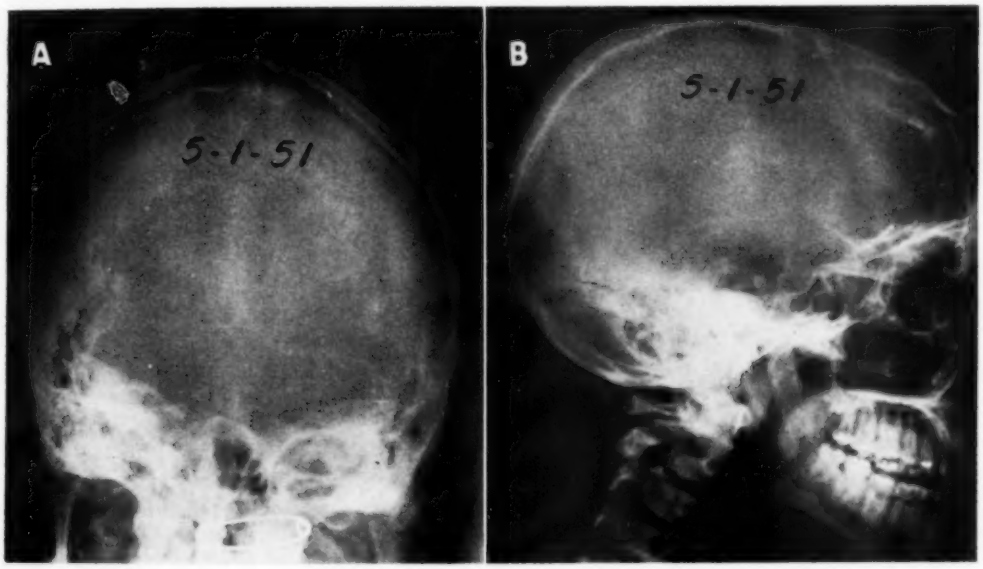
THOROTRAST, or colloidal thorium dioxide, has been used as a diagnostic agent in intracranial lesions in a number of ways—in carotid arteriography, in ventriculography and in outlining cerebral abscesses and cystic brain tumors. The late results of the injection of this medium into a cavity in the brain is the subject of the present paper.



Figs. 1. A and B. Roentgenograms taken immediately after initial admission. (Courtesy Dr. Lofstrom)

A twenty-four-year-old, white male was brought into an emergency hospital in another city by the police on May 1, 1951. He had an odor of alcohol to his breath; he was confused and disorientated. There was a contusion of the scalp in the left parietal region and a laceration of the face. He appeared to understand questions but did not talk, and no history was available. Neurologic examination revealed no localizing signs. The spinal fluid was under increased pressure and was xanthochromic. Roentgenograms of the skull were negative (Fig. 1). A second spinal puncture showed persistent increase in pressure and old blood. The patient continued to be confused. An electroencephalogram on May 11, was reported as indicating a depression in the left temporal area.

On May 15, a craniotomy was performed, revealing an intracerebral hematoma in the left temporal region. This was evacuated, and the resulting cavity was filled with thorotrast (amount not stated) (Fig. 2). Postoperatively, the patient continued to be markedly confused, his speech remained slurred, and there was some sensory aphasia. On May 24, pneumoencephalography showed

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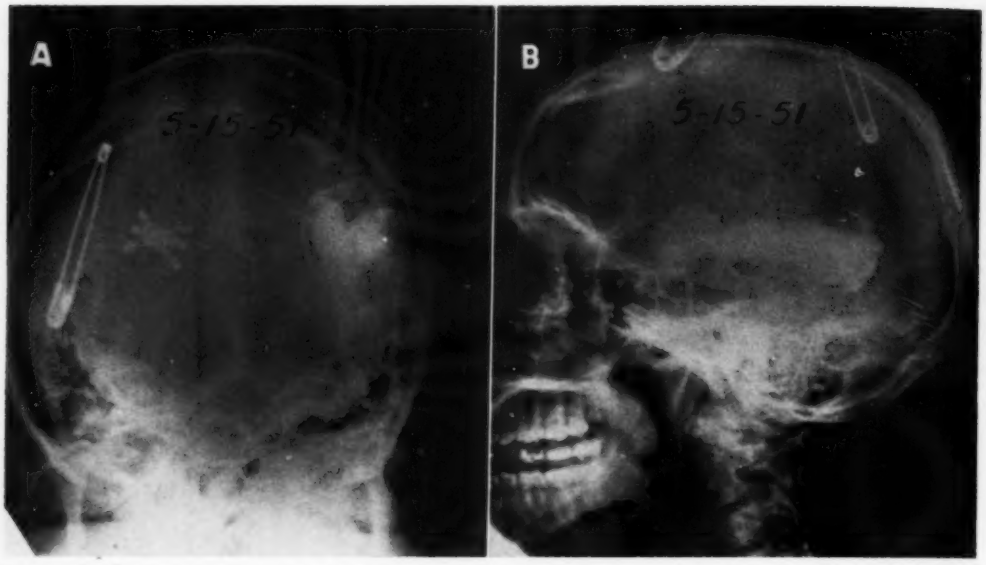


Figs. 2. A and B. Roentgenograms after evacuation of intracerebral hematoma and after injection of thorotrast. (Courtesy Dr. Lofstrom)

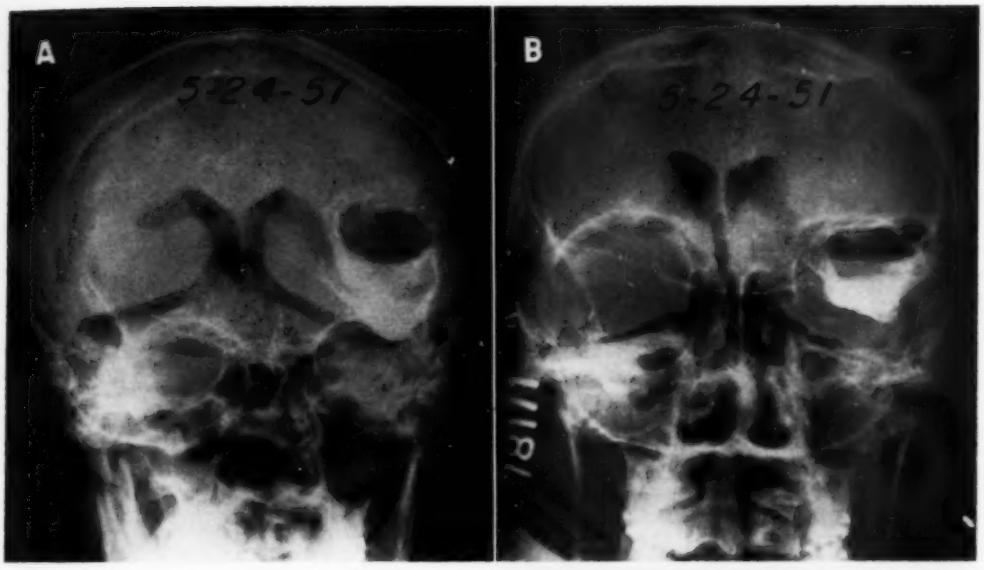
a slight shift of the left lateral and the third ventricles to the right, with the cavity in the left temporal region partly filled with thorotrast (Fig. 3). Following this procedure, the left temporal region was tapped and approximately 70 c.c. of serosanguinous fluid was removed. The patient continued to be aphasic, but his general condition was good enough to permit him to leave the hospital.

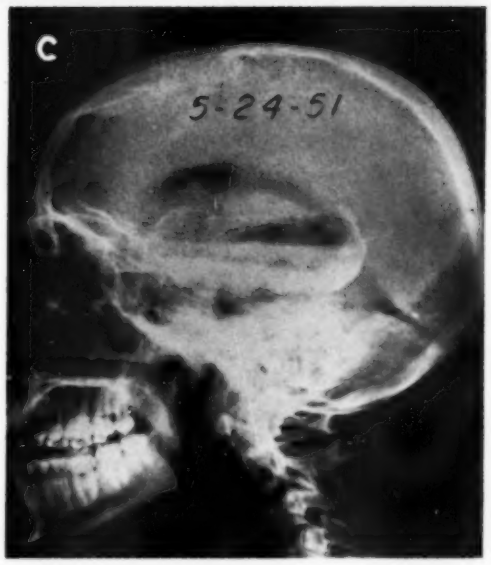
On Jan. 10, 1952, the patient was again hospitalized because he found himself in Chicago without knowing how he had arrived there. He stated that one evening in 1951, while returning home after drinking fairly heavily, he was slugged. He was unconscious for an unknown length of time. Apparently, after regaining consciousness, he was taken to the hospital by the police to have a laceration of his left cheek sutured. He was then returned to jail, but two days later again lost consciousness. When he regained consciousness, he had undergone head surgery. (Part of this history differs from that obtained previously.) He went to his home in Columbia, Tenn., and since that time has had frequent, severe, throbbing, generalized headaches. The headaches were relieved by white pills given him when he was discharged from the first hospital, but they were soon used up. The patient then began to drink heavily to relieve the pain. Sometime in October 1951, he became intoxicated and from that time until his admission here he had complete amnesia.

Physical examination showed only a depressed area in the left parietal region. Neurological examination was negative. Psychologic testing recorded impairment in verbal thinking and evidence of emotional disturbance. Complete blood count, urinalysis, blood calcium and phosphorus, and spinal fluid examination were within normal limits.

Routine x-ray examination of the skull (Fig. 4) revealed a surgical defect in the left parietal bone; the lateral and the third ventricles were outlined as if traced by white ink. In addition, there were large, irregular, calcific densities lateral to the temporal horn of the left lateral ventricle.

An electroencephalogram on Jan. 21, 1952, was reported as abnormal, with a suggestive focus in the left anterior temporal, left temporal, and left frontal regions. Tests with a modified Geiger coun-





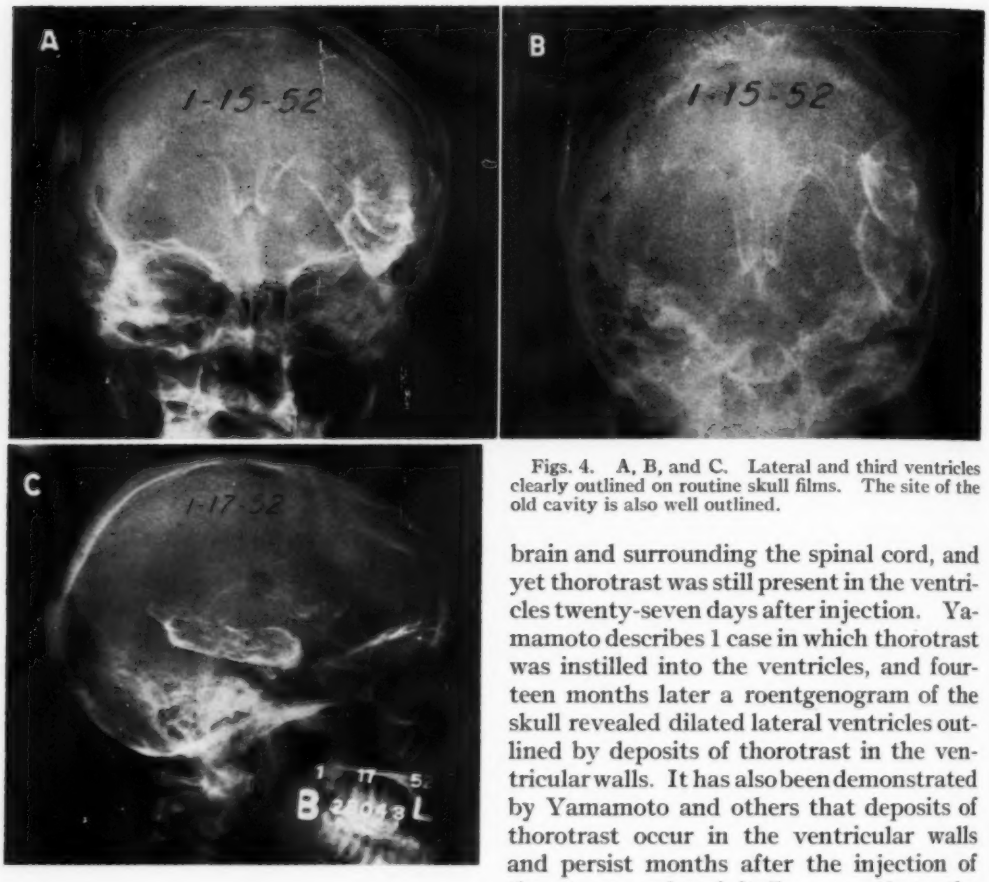
Figs. 3. A, B, and C. Encephalogram. Thorotrast outlines cavity lateral to temporal horn of left lateral ventricle. The lateral ventricles and third ventricle are displaced slightly to the right. (Courtesy Dr. Lofstrom)

ter (bismuth cathode type) over the skull failed to reveal a significant count as might be expected since thorium is an alpha emitter.

DISCUSSION

While the most likely explanation for the visualization of the lateral ventricles and the third ventricle is a deposit of thorotrast, the method by which this occurred is not so evident. In the first place, the cavity in the brain was distinctly lateral to the left lateral ventricle, as demonstrated by the pneumoencephalogram made nine days after the thorotrast injection. At least at that time, there was no communication of the cavity with the ventricle. It would appear entirely possible, however, that an accidental penetration of the ventricle occurred when the serosanguinous fluid was aspirated from the region of the left temporal lobe. Assuming that this took place and that the thorotrast thus reached the ventricular system, the next question is why it should have remained in the ventricles.

Stuck and Reeves injected thorotrast into the ventricles of monkeys and found it could not be demonstrated in the ventricles radiographically after one and one-half to two hours, although some of the substance was present in the ventricular ependyma histologically. Freeman and his colleagues also found that thorotrast disappears from the ventricles several hours after injection. Freeman, however, points out that in a closed cavity the colloidal



Figs. 4. A, B, and C. Lateral and third ventricles clearly outlined on routine skull films. The site of the old cavity is also well outlined.

thorotrast loses its colloidal properties and has a tendency to cling to the surfaces of tissues. Twining and Rowbotham could find only a trace of thorotrast in the ventricles on x-ray examination two hours after injection of 10 c.c., but they removed some of the medium by direct ventricular puncture. Beres found a considerable amount of thorotrast in macrophages lying free in the ventricular cavity and also covering the ependyma twenty-seven days after thorotrast ventriculography. Freeman states that thorotrast disappears from the ventricular cavity in four days in absence of obstruction. Beres, however, found no obstruction to the cerebrospinal fluid flow as shown by the accumulation of thorotrast-laden macrophages in the subarachnoid spaces over the convexity of the brain and surrounding the spinal cord, and yet thorotrast was still present in the ventricles twenty-seven days after injection. Yamamoto describes 1 case in which thorotrast was instilled into the ventricles, and fourteen months later a roentgenogram of the skull revealed dilated lateral ventricles outlined by deposits of thorotrast in the ventricular walls. It has also been demonstrated by Yamamoto and others that deposits of thorotrast occur in the ventricular walls and persist months after the injection of thorotrast suboccipitally, so that the thorotrast may reach the ventricles by means of the subarachnoid pathways. Stuck and Reeves also showed that occasionally thorotrast faintly outlined portions of the ventricular ependyma after cisternal injections in experimental animals.

A possible explanation for the presence of the thorotrast in the ventricles after such a long period is that it had lost its colloidal properties from having been in a closed cavity (as indicated by the work of Freeman), and when it was then accidentally transferred to the ventricles it clung to the walls much more readily. At any rate, it seems more plausible that the thorotrast somehow reached the ventricles directly rather than leaking out and eventually getting to the ventricles by way of the sub-

arachnoid spaces. The entire question of how the ventricles were outlined by thorotrast might have been established definitely, if films of the skull had been made soon after the fluid was aspirated from the region of the left temporal lobe. Unfortunately none were made at that time.

One other possibility was considered initially before the history of thorotrast instillation into the cavity in the brain was obtained, namely, calcification of the walls of the lateral and third ventricles. However, in a review of the Quarterly Cumulative Index Medicus from 1931 through 1951, no such instance was recorded, and there are many reports of subdural hematomas. It seems likely that calcium is present at the site of the intracerebral hematoma, with possibly some thorotrast at this site also.

SUMMARY

1. A case is presented in which the lateral ventricles and the third ventricle were visualized about eight months after the injection of thorotrast into a cerebral cavity not communicating with the ventricles.

2. Possible ways by which the thorotrast reached the ventricles are discussed.

ACKNOWLEDGMENT: I am indebted to Dr. O. G. Fais for kindly supplying me with a transcript of clinical records of the initial hospitalization.

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SUMARIO

Visualización Fortuita de los Ventrículos Meses Después de la Inyección Intracraneal de Torotrasto

Preséntase un caso en el que se visualizaron los ventrículos laterales y el tercer ventrículo unos ocho meses después de haberse inyectado torotrasto en una cavidad cerebral que no se comunicaba con los ventrículos.

Discútense posibles modos en que el torotrasto llegó a los ventrículos. Una explicación de la presencia del torotrasto en los ventrículos al cabo de tanto tiempo consiste en que había perdido sus propiedades coloidales por haber estado en una cavidad cerrada, y que al ser trasladado accidentalmente a los ventrículos, se adhirió mucho más fácilmente a las paredes. De todos modos, parece más plausible que el torotrasto llegó en alguna forma directamente a los ventrículos que no que se escurrió y penetró a la larga en ellos por vía de los espacios subaracnoideos.

Aseptic Necrosis of Bone in Sickle-Cell Disease[1]

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SICKLE-CELL anemia is a hereditary and familial chronic hemolytic anemia resulting from abnormalities of the hemoglobin molecule and is distinguished by peculiar sickle-shaped red blood cells. It is clinically characterized by anemia, abdominal crises, joint pains, leg ulcers, and other manifestations depending on the organs involved. These manifestations stem from the basic pathologic processes of excessive blood destruction, abnormal erythropoiesis, thrombosis, and infarction. It is to be differentiated from the sickle-cell trait in which there is neither anemia nor reputedly clinical manifestations, but in which the erythrocytes may be made to sickle under proper conditions. It should be noted, however, that Bauer (1) has described cases in which bone and joint pain and acute abdominal pain were attributed to the sickle-cell trait in the absence of anemia. Wintrobe (2) and others feel that the trait is harmless except that it can be transmitted, and that the evidence offered so far is not adequate to prove the existence of clinical manifestations in the absence of anemia.

While sickle-cell disease has been described in other races including whites (3–7) it is essentially peculiar to the Negro. The sickling trait has been estimated to occur in approximately 7 per cent of the North American Negro population. It is generally believed that 1–2 per cent of those with sickle-cell trait develop the hemolytic anemia (8).

The skeletal changes which may occur in sickle-cell disease have been reported by numerous authors (9–15). These osseous abnormalities include widening of the medullary cavities with thinning of the cortices and coarsening of the trabeculae, osteoporosis, osteosclerosis, narrowing of the medullary cavity with thickening of the inner aspect of the cortices in long bones, cupping of demineralized vertebrae, and aseptic necrosis. Such bone derangements presumably reflect the marrow hyperplasia, thromboses, and infarctions characteristic of sickle-cell anemia.

It is the object of this article to present 5 cases of sickle-cell disease, all of which showed roentgenographic evidence of an aseptic necrosis of bone but with a variation of clinical complaints, ages, associated osseous abnormalities, and hematologic findings.

CASE I: C. R., a 38-year-old colored male baker, was first admitted to the hospital Oct. 24, 1950, complaining of pain in both hips and the left shoulder of four years duration. Physical examination revealed marked limitation of passive abduction and rotation of the left shoulder and pain with marked limitation of motion in all planes in both hips. There were, in addition, numerous abnormal neurological findings.

The blood count showed hemoglobin 14 gm., 4,650,000 red blood cells, 5,900 white blood cells, with 57 per cent neutrophils, 40 per cent lymphocytes, 3 per cent monocytes. Alkaline phosphatase was 3.8 Bodansky units; phosphorus 2.9 mg. per cent; calcium 10.9 mg. per cent. Kline and Mazzini tests were negative. Urinalysis was also negative. There was no significant temperature elevation.

X-ray examination of the chest showed no abnormalities of the heart or lungs. Skeletal survey revealed marked sclerosis associated with areas of rarefaction in the head of the left femur (Fig. 1). The head was malshaped and flattened on its superior aspect. There were secondary hypertrophic arthritic changes about the joint. The right femoral head showed similar though less marked changes. Secondary hypertrophic arthritic changes were demonstrated about this joint also. There was bone destruction and production in the head of the left humerus and the trabeculae in the head and neck of the right humerus were sclerosed (Figs. 2 and 3). The findings were interpreted as those of aseptic necrosis due to bone infarction. The remaining skeleton showed no abnormalities.

[1] From the Department of Radiology and the Orthopedic Section of the Department of Surgery, Sydenham Hospital, New York, N. Y. Accepted for publication in June 1952.

Fig. 1. Case I. Bilateral aseptic necrosis of the femoral heads. The weight bearing portion of the left femoral head is flattened. There are secondary hypertrophic arthritic changes about both joints.

The patient was referred to a neurological hospital for study of the nervous system. He returned with a diagnosis of multiple sclerosis and sickle-cell disease.

The significant laboratory findings at that institution were as follows: Erythrocyte sedimentation rate 3 mm. in one hour; hemoglobin 13 gm.; red blood cells 5,190,000, white blood cells 6,500 with polymorphonucleocytes 68 per cent, lymphocytes 30 per cent, monocytes 1 per cent, eosinophils 1 per cent. Reticulocytes ranged from 3 to 6 per cent on two counts. One hundred per cent sickling was present after twenty-four hours. The urine was negative for urobilinogen, and the bilirubin was 0.3 mg. per cent (indirect). The direct Coombs' test was negative. Bone marrow studies showed only very slightly increased erythropoiesis.

There was a suggestive history of retrobular neuritis thirteen years before; neurological findings pointed to lateral pyramidal involvement, involvement of the posterior longitudinal fasciculus, and of both optic nerves.

The patient was readmitted to Sydenham Hospital Feb. 6, 1951, for treatment of his joint pains. At this time the blood again showed 100 per cent sickling after twenty-four hours but no anemia. Repeated laboratory examinations confirmed the findings already stated.

Comment: The complaint which brought this 38-year-old patient to the hospital was joint pain. There was no obtainable history of abdominal crises and no icterus. The urine was negative for urobilinogen, and the bilirubin was normal. The red blood cell count and hemoglobin were within what is ordinarily considered the normal range. These findings would not justify a diagnosis of a hemolytic anemia and the presence of 100 per cent sickling in twenty-four hours would suggest that only the trait was present. This is a controversial point which we do not propose to labor in this report. It is interesting to note, however, that opinions have been expressed that all shades of variation may occur between the trait and severe anemia. Wintrobe, nevertheless, states that in his experience "remissions have never been of such a degree that no icterus was present and all anemia had disappeared." This patient presented radiographic evidence of

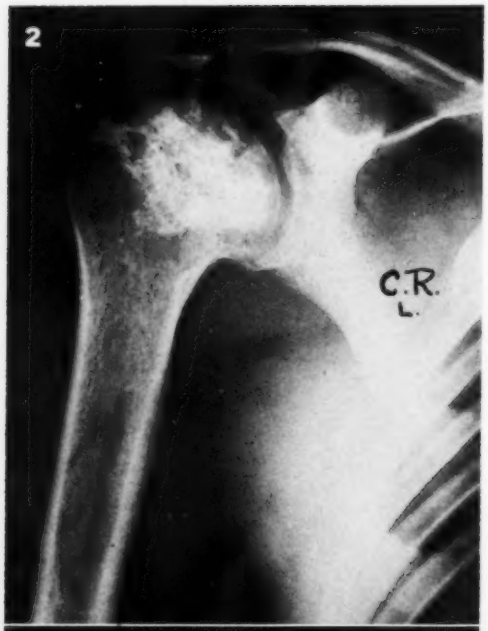

Fig. 2. Case I. Aseptic necrosis of the head of the left humerus. There are mottled areas of increased density with fibrocystic areas of rarefaction.

Fig. 3. Case I. Bone sclerosis in the neck and head of the right humerus.

aseptic necrosis of the hips and shoulders with secondary degenerative arthritic changes at the weight bearing joints. No other cause for such changes could be demonstrated. There was sickling but no anemia. It is therefore suggested that in the presence of aseptic necrosis, particularly in a colored patient, despite the absence of anemia, sickling should be considered along with other possible etiologies and tests for sickling should be performed.

CASE II: H. O., a 34-year-old colored female, was admitted to the hospital Sept. 27, 1951, complaining only of pain in both thighs of two months duration. She stated that she had been hospitalized elsewhere in 1949 for pneumonia and had been operated upon in 1935 for an ectopic pregnancy. Physical examination revealed no significant abnormalities except those referable to the hips which both showed adductor spasm and tenderness to pressure in both inguinal regions. Her temperature on admission was 98.2° but shortly thereafter it ranged around 99°, with an occasional elevation to 100°.

Laboratory findings: Red blood cell count 3,950,000, hemoglobin 11.7 gm., white blood cell count 7,400. Urinalysis was negative. Erythrocyte sedimentation rate 34 mm. in one hour; cholesterol 222 mg. per cent; calcium 10.7 mg. per cent; phosphorus 4.0 mg. per cent; alkaline phosphatase 4.8 Bodansky units. Blood Wassermann was negative.

X-ray examination of the chest revealed a segmental atelectasis of the right lower lobe. Roentgenograms of the hips showed an aseptic necrosis of the heads of both femora (Figs. 4 and 5). A skeletal survey disclosed no other bone abnormalities. These findings prompted a sickling test which showed 100 per cent sickling. Since the patient had no complaint referable to her chest, gastric washings were taken for culture which revealed acid-fast bacilli.

Comment: This 34-year-old patient denied any history of acute abdominal pain and maintained that save for the chest condition in 1949 and the ectopic pregnancy in 1935 she had enjoyed good health. The complaint of pain in both thighs was said to be of only two months duration. The anemia was not severe. Pulmonary complications such as pneumonitis, infarction, and tuberculosis are fairly common in sickle-cell anemia. Bone infarctions are usually silent in their early stages, and there are variable periods of delay between the interruption of circulation and the radiographic changes and pain. The finding of aseptic necrosis prompted the sickling test and was responsible for the diagnosis in this case. The femoral necroses existed in the absence of any other demon-

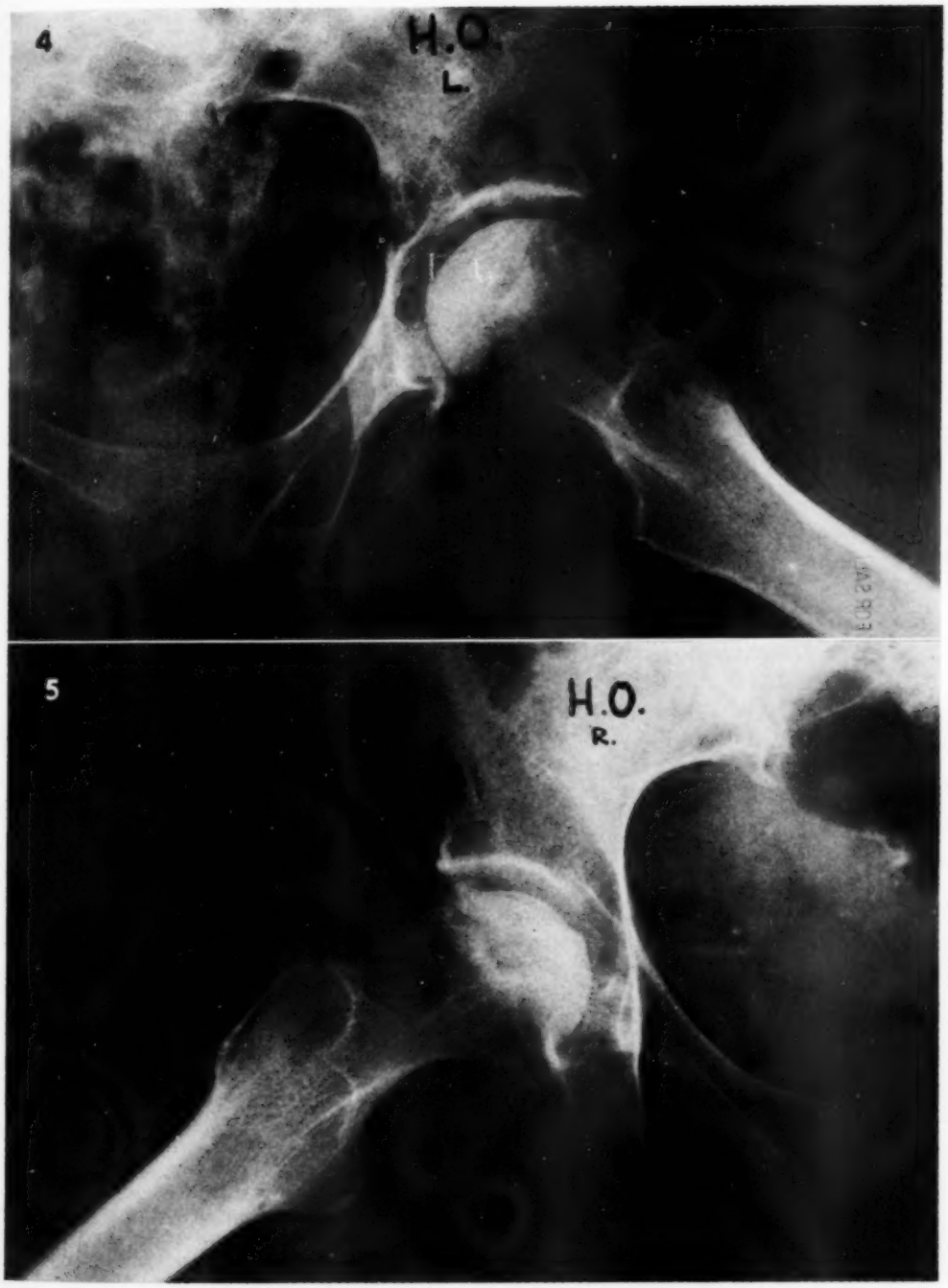

Fig. 4. Case II. Areas of decreased and increased density in head of left femur. There is a depressed sequestrum at the weight bearing portion of the bone, suggestive of osteochondritis dissecans but surrounded by sclerotic bone.

Fig. 5. Case II. Aseptic necrosis of head of right femur with depressed sequestrum and sclerotic adjacent bone.

Fig. 6. Case III. Areas of increased and decreased density in both femoral heads, necks, and trochanters. Diffuse osteosclerosis in spine and mesial aspects of the iliac bones.

strable radiographic features of sickle-cell anemia.

CASE III: H. E., a 31-year-old colored male, was admitted to the hospital Oct. 7, 1951, complaining of acute abdominal pain, tarry stools, blood in the urine and pain in both hips and back. He had been operated upon at another hospital a year before for cholelithiasis and had been told seven years before that he had sickle-cell anemia for which he received a blood transfusion. Physical examination revealed a soft abdomen with generalized tenderness. There was also tenderness in the left costovertebral angle. The temperature never exceeded 100° F.

Radiographic examination of the gastrointestinal tract, excretory urography, and retrograde pyelography disclosed no abnormalities of these systems. On cystoscopy, occasional areas of submucosal hemorrhage were seen in the posterior urethra. A diffuse osteosclerosis, however, involved the lower dorsal and lumbar vertebrae and the pelvic bones (Fig. 6). The medullary cavities of the femora were narrowed by cortical thickening, and both hips and shoulders showed aseptic necrosis.

Laboratory findings: Red blood cells 3,500,000, hemoglobin 11 gm. There was a moderate leukocytosis. Sickling was positive. The urine was cloudy and blood tinged, with a specific gravity of 1.010, albumin 2 plus, and numerous red blood cells. The blood Wassermann was negative. A diagnosis of sickle-cell crisis was made. The patient was treated conservatively and the process subsided.

Comment: This 31-year-old patient represents a typical case of sickle-cell ane-

Fig. 7. Case IV. Mottled areas of increased and decreased density throughout the left femoral epiphysis. The epiphysis is flattened and compressed. There is a rectangular area of rarefaction with increased density of the surrounding bone in the metaphysis.

mia admitted to the hospital in abdominal crisis. The bone changes illustrate aseptic necrosis in the presence of osteosclerotic changes.

CASE IV: V. C., a 7-year-old colored Puerto Rican male, was admitted to the hospital on Jan. 28, 1952, complaining of abdominal pain and dark urine of two days duration. Five days previously he had contracted an upper respiratory infection with cough. Two days prior to admission severe abdominal pain, joint pain, dysuria, dark urine, and fever developed. According to the mother, the patient since infancy had occasional attacks of lower abdominal pain with fever, dark urine, and pains in the joints.

Physical examination showed a poorly nourished Negro child with moderately icteric scleri. The heart was enlarged to the anterior axillary line, with a Grade 2 systolic murmur at the apex and base. There was slight dullness at the right lung base with medium moist râles. The spleen was not palpable. The extremities were normal.

Laboratory findings: The specific gravity of the urine was 1.012; and the urobilinogen, 4.9

mg. excreted in twenty-four hours. The stool urobilinogen was 536 mg. in twenty-four hours. The erythrocyte sedimentation rate was 5 mm. in one hour; hemoglobin 6 gm.; white blood cell count 30,000, with a normal differential count. Many sickled cells were present on smear. The Wassermann was negative. Blood urea nitrogen 20 mg. per cent; bilirubin 2.6 mg. per cent (indirect), direct van den Bergh reaction positive; total proteins 7.8 gm., albumin 3.8 gm. per cent, globulin 4.0 gm. per cent. A tuberculin test was negative.

Fig. 8. Case IV. Osteoporosis of the dorsal spine with beginning cupping of the vertebrae.

X-ray examination was made of the skull, spine, and long bones. There were no abnormalities of the bones of the calvarium (Fig. 9). There was, however, demineralization of the spine with beginning cupping of the dorsal vertebrae (Fig. 8). The bones of the pelvis were moderately porotic, with coarsened trabeculae. There was an aseptic necrosis of the head of the left femur (Fig. 7). A diagnosis of sickle-cell crisis and right lower lobe pneumonia was made. The patient was treated with intravenous fluids and penicillin and was given transfusions. He recovered rapidly and was discharged from the hospital Feb. 12, 1952.

Comment: This case illustrates the occurrence of aseptic necrosis of one femur in a child of seven years. This osseous necrosis was found in conjunction with osteoporosis. The more commonly described lesion in children, *i.e.*, diploic widening, striation and thinning of the outer table of the skull, was not present.

Fig. 9. Case IV. There are no abnormalities of the bones of the calvarium. The triangular density in the frontoparietal region is an artifact.

CASE V: B. P., a 17-year-old colored female, was admitted to the hospital Dec. 26, 1951, complaining of severe pain in the back of one days duration. She stated that she had had numerous attacks of back and joint pain during the past three years, all of which subsided spontaneously. One sister was said to have died from sickle-cell anemia. Physical examination revealed no significant abnormalities aside from spasm of the lumbar muscles and some generalized tenderness over the lumbar spine. No abnormalities of the joints were noted. The temperature was 102° F.

Laboratory findings were as follows: red blood cell count 2,800,000, hemoglobin 7 gm. There were 6 per cent nucleated red blood cells. White blood cell count 13,200; erythrocyte sedimentation rate 7 mm. in one hour. Urinalysis was negative. Sickling was positive. Icteric index 11.

X-ray examination of the chest disclosed no abnormalities of the heart or lungs. A skeletal survey showed sclerosis of the head of the left femur, within which there were several small rounded areas of rarefaction (Fig. 10). There was also a diffuse sclerosis of the heads of both humeri (Figs. 11 and 12). The spine was osteoporotic with cupping of the demineralized vertebrae (Fig. 13). The remainder of the skeleton, including the skull, was normal. There was no splenic enlargement. The patient was given transfusions and treated sympto-

Fig. 10. Case V. Areas of increased and decreased density in the head and neck of the left femur.
Fig. 11. Case V. Increased density of the trabeculae throughout the head of the right humerus.

matically. She recovered rapidly and was discharged Jan. 26, 1952.

Comment: This 17-year-old patient illustrates the occurrence of aseptic necrosis in the humeri and left femur in conjunction with vertebral osteoporosis. No other osseous abnormalities were noted. The patient's complaints were entirely referable to the spine and joints.

DISCUSSION

Sickling is intimately associated with the state and nature of the hemoglobin within the erythrocyte. Sickle-cell erythrocytes, when combined with oxygen or carbon monoxide, appear in no way to differ from a normal erythrocyte. In the uncombined state, however, sickle-cell hemoglobin seems to aggregate into one or more foci and the cell membranes collapse. The cells become birefringent and rigid. This condition may be reversed by the addition of oxygen or carbon monoxide. The erythrocytes of sickle-cell trait require a much greater reduction of the partial pressure of oxygen for a major fraction of the cells to sickle than do the erythrocytes of sickle-cell anemia (16). According to Sherman from 30 to 60 per cent of the erythrocytes in the venous circulation of sickle-cell anemic individuals are normally sickled as compared to only 1 per cent of those of individuals with the sickle-cell trait. Under very low oxygen pressure, however, all the cells of both types may be made to sickle.

Pauling, *et al.* (17) have shown that there is a significant difference between the electrophoretic mobilities of hemoglobin derived from erythrocytes of normal individuals and that from sickle-cell anemic individuals. The hemoglobin derived from erythrocytes of individuals with sicklemia (trait), however, appears to be a mixture of normal hemoglobin and sickle-cell anemia hemoglobin in roughly equal proportions. This would appear to be quite consistent with the report of Neel (18) which indicates that the gene responsible for the sickling characteristic is in a heterozygous condition in individuals with sickle-cell trait and homozygous in those with sickle-cell anemia.

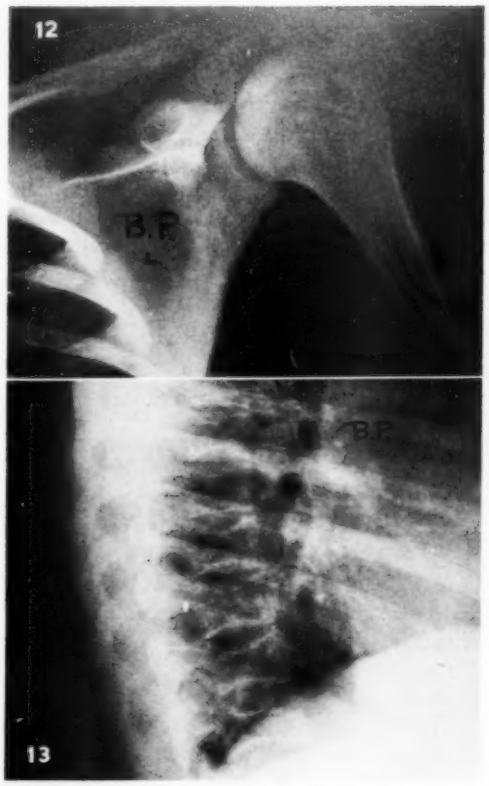

Fig. 12. Case V. Diffuse sclerosis throughout the head of the left humerus similar to that found on the right side.

Fig. 13. Case V. Demineralization of the spine with cupping of the vertebrae, presumably due to pressure of the nucleus pulposus on the weakened vertebral bodies.

Sickled erythrocytes become elongated and rigid. It is assumed that this elongation and rigidity cause blockage of the small vessels with resultant infarction and necrosis. The aseptic necrosis which occurs in sickle-cell disease does not appear to differ from that resulting from aseptic interruption of the circulation from other causes.

In the American literature we are indebted to Phemister (19, 20), in large measure, for excellent studies of the changes in bones and joints resulting from interruption of circulation, and roentgenologists have in recent years played an increasingly

important role in the recognition of these pathologic processes. According to Phemister changes in the density of the bone in necrosis may result from "atrophy of disuse, from creeping replacement of dead bone by new bone, from pathologic fractures and collapse of the dead bone bordering on joints, from compression of dead trabeculae, from infiltration of bone sand into the dead marrow spaces and from calcification of the line of demarcation and the interior of old stationary necrotic areas located in the medullary and cancellous regions."

Aseptic necrosis as seen in sickle-cell disease may resemble the radiographic changes occurring in caisson disease, Legg-Perthes disease, slipped femoral epiphysis, advanced hypertrophic arthritis and necrosis following interruption of the circulation in fractures of the femoral neck and dislocation of the femoral head. Invasion of the femoral neck and head in Gaucher's disease may also create a somewhat similar appearance.

The cases described above indicate that aseptic necrosis may occur in sickle-cell disease in a wide variety of ages, being demonstrated in patients from seven to thirty-eight years. In this small series of cases there was no definite correlation between aseptic necrosis and the severity of the disease, and necrosis was seen in the presence of osteoporosis, osteosclerosis, and without other demonstrable bone changes. We feel that the occurrence of aseptic necrosis apparently due to sickle-cell disease in the presence of a normal blood count is particularly significant. It suggests that in the presence of clinical or radiographic findings consistent with sickle-cell disease, a normal blood count does not exclude such a diagnosis.

SUMMARY

1. Five cases presenting aseptic necrosis of bone in the presence of sickle-cell disease are reported.

2. The age of the patients ranged from seven to thirty-eight years.

3. There is no direct correlation between the severity of the disease and the occurrence of bone necrosis.

4. Aseptic necrosis may be present associated with osteosclerosis, with osteoporosis, and also in the absence of any other osseous abnormality.

5. One case is reported in which the skeletal changes occurred in the presence of a normal blood count and hemoglobin.

ACKNOWLEDGMENT: We are indebted to Dr. Horace Hodes, Department of Pediatrics, Mt. Sinai Hospital, for permission to use Case IV.

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SUMARIO

Osteonecrosis Aséptica en la Drepanocitemia

La drepanocitemia, o anemia por células falciformes, es una anemia hemolítica crónica hereditaria y familiar, debida a anomalías de la molécula de la hemoglobina y caracterizada por la presencia de eritrocitos falciformes. Distínguese clínicamente por anemia, crisis abdominales, dolores articulares, úlceras en las piernas y otras manifestaciones que varían de acuerdo con los órganos afectados. Esas manifestaciones proceden de los procesos patológicos fundamentales de hiperhemólisis, eritropoyesis anormal, trombosis e infarto. La dolencia tiene que ser diferenciada de la mera característica falciforme, en la que no existen ni anemia ni manifestaciones clínicas declaradas, pero en la que los eritrocitos toman forma de hoz en ciertas circumstancias

La necrosis aséptica observada en la drepanocitemia puede semejar las alteraciones radiográficas que tienen lugar en la enfermedad de los caissons, la enfermedad de Legg-Perthes, la epifisiolisis, la artritis hipertrófica avanzada y la necrosis consecutiva a interrupción de la circulación en las fracturas del cuello del fémur y la luxación de la cabeza de este hueso. La invasíon del cuello y de la cabeza del fémur en la enfermedad de Gaucher puede también crear un aspecto algo similar.

Preséntanse 5 casos de necrosis aséptica con drepanocitemia. Indican los mismos que puede haber necrosis aséptica en la drepanocitemia a edades muy variadas, oscilando entre siete y treinta y ocho años en este grupo. No hubo en la serie correlación bien definida entre la necrosis y la gravedad de la enfermedad, observándose aquélla cuando existían osteoporosis y osteosclerosis y sin notarse otras alteraciones óseas. En un caso, las alteraciones esqueléticas coincidían con cifras normales de glóbulos sanguíneos y hemoglobina.

Radiological Study of the Temporomandibular Joints[1]

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STUDY OF THE temporo-mandibular joints calls for special roentgen technic and a thorough understanding of the anatomy and physiology of these joints. Very little space is devoted to this subject in textbooks, and relatively few articles find their way into the radiologic literature. The complaint of crepitation, snapping, and disorders of movement of the temporo-mandibular joints is fairly common, and we believe that more attention should be devoted to their roentgen study.

The temporo-mandibular joints are unique in that they are twin joints located at either end of a horseshoe-shaped bone and functioning is unison. They also have unusual movements not present in other joints, which are peculiarly adapted to their functional needs.

The temporo-mandibular joint belongs to the class of true articulations with cartilage-covered joint surfaces, synovial membrane, and joint space; and to the class of compound joints because of the inserted meniscus which divides the joint into two cavities, an upper and a lower. It is a combination hinge joint with a free range of motion, in which a gliding motion and rotary motions are prominent features.

ANATOMY

The articular surfaces are composed of the glenoid fossa, the mandibular condyle, and the meniscus. The glenoid fossa is formed by the anterior root of the zygomatic process of the temporal bone. The fossa is limited anteriorly by a slight eminence, the eminentia articularis. The anterior portion of the glenoid fossa and the eminentia articularis are covered with fibrocartilage. The posterior portion is called the posterior articular lip. The mandibular condyle is a bony cylinder whose longitudinal axis is identical with that of the glenoid fossa. Only the anterior portion of the condyle is covered with fibrocartilage and it is this portion which articulates with the anterior portion of the glenoid fossa and the posterior portion of the eminentia articularis. The meniscus is an oval biconcave disk of fibrocartilage which is molded into the glenoid fossa and around the condyle. This divides the joint cavity into two completely separate spaces which do not freely communicate. The capsule is lax and is attached to the upper joint surface and the neck of the condyle. It is fused with the disk in its entire circumference. The capsule in the area between the temporal bone and the meniscus is loose to allow the free sliding motion in the upper compartment of the joint. Between the meniscus and the condylar attachment, however, the capsule is much tighter. This snug attachment allows the meniscus to return to the glenoid fossa when the mouth is closed.

MANDIBULAR MOVEMENTS

The anatomical arrangement of the temporo-mandibular joint structures is such that three main types of motion are possible.

1. The hinge motion, which takes place between the meniscus and the condyle, thus allowing the opening and closing of the mouth.
2. Gliding motion, which takes place by movement of the meniscus in the fossa and allows protrusion and, to a slight degree, retraction of the mandible.

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3. Rotary motion, which is accomplished by forward glide of one condyle and rotation of the other condyle on a vertical axis.

In opening the mouth, the hinge motion occurs between the condyle and the meniscus, although some authors believe this to be slight and that the motion occurs almost entirely through a tilting of the meniscus and condyle acting as a unit, with the axis of tilt at the anterior portion of the condyle and meniscus. At the same time the meniscus and condyle glide forward and downward to lie beneath the articular eminence, and may glide slightly anterior to it. This is due to movement in the upper joint cavity. This movement of the meniscus is made possible by the insertion of the external pterygoid muscle in the capsule and thus in the meniscus. This muscle is the principal activator of the forward gliding motion. The meniscus acts as a shock absorber by virtue of its ability to mold itself to accommodate and equalize pressure effects during mastication. This movement of the meniscus produces the effect of a wandering joint surface for the condyle.

Simple protrusion of the mandible with the mouth closed brings the condyle forward against the posterior border of the articular eminence. When the mandible is retracted, the condyle comes to rest against the posterior articular lip and not against the tympanic plate. Medially the articular fossa contains a bony lip which prevents medial displacement of the condyle.

ANATOMIC TYPES

1. *Normal Joint:* It has the normal rounded articular surfaces to permit the normal movements of the jaw found in the normal over-bite.
   a. A normal convexity of the articular surface of the condylar head and the articular eminence.
   b. A moderate forward tilt of the neck of the condyle.
   c. A moderately shallow fossa. In the open position the condyle lies just below the articular eminence.
2. *Flattened Gliding Joint:* It is found chiefly in the edge-to-edge bite. It shows the following in the centric rest position.
   a. Flat articular surface of the condylar head and articular eminence.
   b. Flat horizontal course of the roof of the fossa.
   c. A very slight angle of inclination of the neck of the condyle.

   The distance between the articular surface of the condyle and the articular eminence is often greater than in the so-called normal joint. The condyle glides forward excessively in the open position.
3. *Marked Convex Joint:* This type is found chiefly in persons with marked over-bites and allows increased rotary function. In the centric position it shows the following.
   a. Marked convexity of the condylar head and the articular eminence.
   b. Deep mandibular fossa.
   c. Exaggerated forward tilting of the condylar neck.
   d. Reduced disk space, which is believed to represent compression of the meniscus.

   This type of joint is seen frequently in patients with posterior occlusion.

CLINICAL FINDINGS

Oral surgeons believe that dental occlusal abnormalities influence and alter the anatomic arrangement of the temporomanibular joints, resulting in local symptoms. These symptoms may be characterized by crackling, noisy, painful, jerky movements of the condyles during opening and closing of the jaw.

Bellinger (1) states that the acute symptoms are usually preceded by a history of a

snapping sound in the joint. This may occur intermittently or at the termination of the opening movement, and indicates joint derangement. It is unusual during the closing movement. In all cases of snapping or noisy joints, the meniscus is at fault. In many cases the audible snapping is the only clinical evidence of disorder, but in others the symptoms progress to a very marked degree. They may include palpable tenderness, pain, and restriction of motion. Other reflex symptoms are often present. Among these may be pain within and about the ears, tinnitus, and a stuffy sensation in the ears.

These joints are frequently subjected to unilateral stress, due to certain dental abnormalities, and here, as in other areas, reaction to unaccustomed strain causes first an acute symptomatology and later anatomic joint derangement. There may be evidence of pain, swelling, muscular spasm, and limitation of motion. If the condition is allowed to go on without treatment, it may progress to degeneration of the joint structures with evidence of decrease in joint space, changes in the normal movement of the condyle, and even bone erosion and bone production. The meniscus becomes thinned by abnormal pressure against the articular eminence and may perforate. The condyle may occupy abnormal positions in the glenoid, either against the articular eminence anteriorly or against the tympanic plate.

The changes which have been described above represent essentially a chronic degenerative arthritis similar to that seen in other peripheral joints. It is a condition which is prone to develop in older persons, but one in which trauma, often due to malocclusion, plays a prime role.

While the former conditions are usually associated with some type of trauma, the temporo-mandibular joints may also be involved in other generalized arthritis or acute pyogenic arthritis. In generalized Marie-Strümpell arthritis, these joints may be involved, with a resulting stiffness or even ankylosis. In patients with rheumatoid arthritis, acute pain and limitation of motion may occur. This may go on to chronic restriction of motion if unchecked. According to some authors, the incidence of temporo-mandibular involvement in acute rheumatoid arthritis may run as high as 20 per cent. Acute suppurative involvement of the joint is more likely to occur by direct extension from acute cellulitis and suppuration of the surrounding soft tissues than from metastatic infection. This often results in destruction of the joint surfaces with a true bony ankylosis or at least a fibrous ankylosis.

Ankylosis of the temporo-mandibular joints occurs more frequently in children, and may be associated with an acute inflammatory condition. The latter may be caused by an acute infection, or as a result of trauma, usually from a blow on the symphysis of the mandible. Mastoid infection with extension through the tympanic plate may be the etiologic factor. These types of ankylosis are usually unilateral. They usually result in underdevelopment of the chin in later years.

ROENTGENOGRAPHIC TECHNIC

The roentgenographic technic requires both careful attention to detail and cooperation of the patient, if accurate information is to be obtained from the films. Several positions are useful.

Films made in the lateral oblique position are of most value. In this position, one sees the anteroposterior relationship of the condyle to the glenoid fossa and the articular eminence and the width of the joint space. We employ the Hodges skull apparatus with the Bucky diaphragm in the vertical position and the patient seated comfortably before this. The exact location of the mandibular fossa is located by placing the finger over the area indicated by the patient opening and closing the mouth. This area is then placed directly over the center point of the grid. The face is allowed to come to rest supported by the malar eminence and the anterior mandible. This produces an anterior tilt of 15 degrees. The self-centering tube is now shifted 23 degrees cephalad,

and stereoscopic films are made in this position. With the patient in the same position, a cloth-covered cork, of varying size up to 1 5/8 inches, is placed between the teeth, and stereoscopic films are made in the open-mouth position. Both right and left sides are similarly examined. This examination requires four 8 × 10-inch films.

Another view of value which demonstrates the joint structures in their lateral relationship is the postero-anterior projection. This is made with the Bucky diaphragm in the vertical position. The forehead nose position is used with the mandibular fossa opposite the mid-point of the film. The open-mouth position with the cork between the teeth is again used. The self-centering tube is displaced downward so that the central ray is angled cephalad at a 30-degree angle to the film.

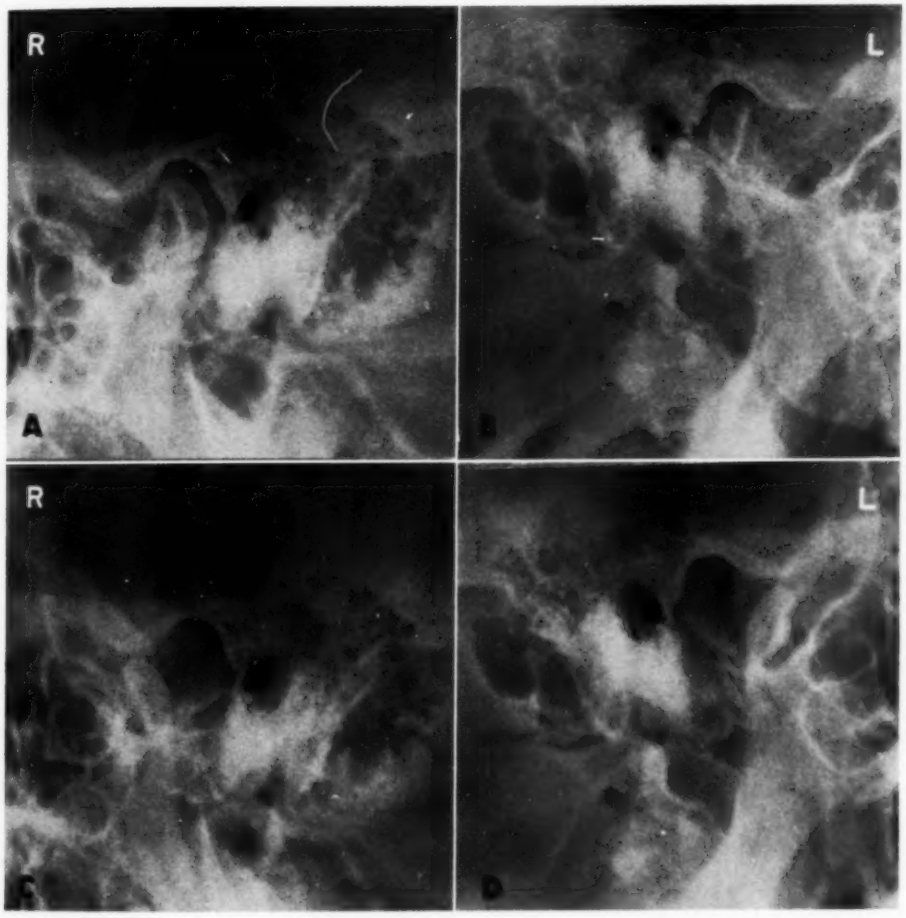

Fig. 1. Case I. (No. 234158): Normal anatomic type. Free movement of condyles in open position. Slight clouding of the right joint space. Treated with heat and joint rest. Good result.

Another position which is sometimes of value is a slight modification of the Towne position. The patient lies supine on the table, with the foramen magnum over the center of the film, which is elevated at an angle of 35 degrees. The chin is flexed as much as possible. The central ray is perpendicular to the horizontal plane and the central ray is focused over the mid-

line 3 inches above the nose. We have not used this position routinely, as good visualization of the joints has not been easily reproducible.

In some cases the submento-vertex position has been of value, and we are now using this during a trial period to test its value. The patient sits upright with the Bucky diaphragm horizontal. The head is tipped back so that Reid's base line is parallel to the film and perpendicular to the central ray. This is easily accomplished with the Hodges head machine.

Arthrography has been described by Nørgaard (3) of Copenhagen. He injects a radiopaque contrast medium into the upper or lower joint space, after which radiographs are made in the closed and open positions. He uses an aqueous iodine-containing solution known as Perabrodil, 35 per cent. The outline of the filled joint space is thereby demonstrated. By this method Nørgaard claims that rupture of the capsule, perforation of the disk, and other soft-tissue changes can be visualized. He states that the procedure is attended by little or no pain, and that the contrast medium is absorbed within fifteen minutes. We have no practical experience with this method, but several American observers have found certain difficulties in carrying it out.

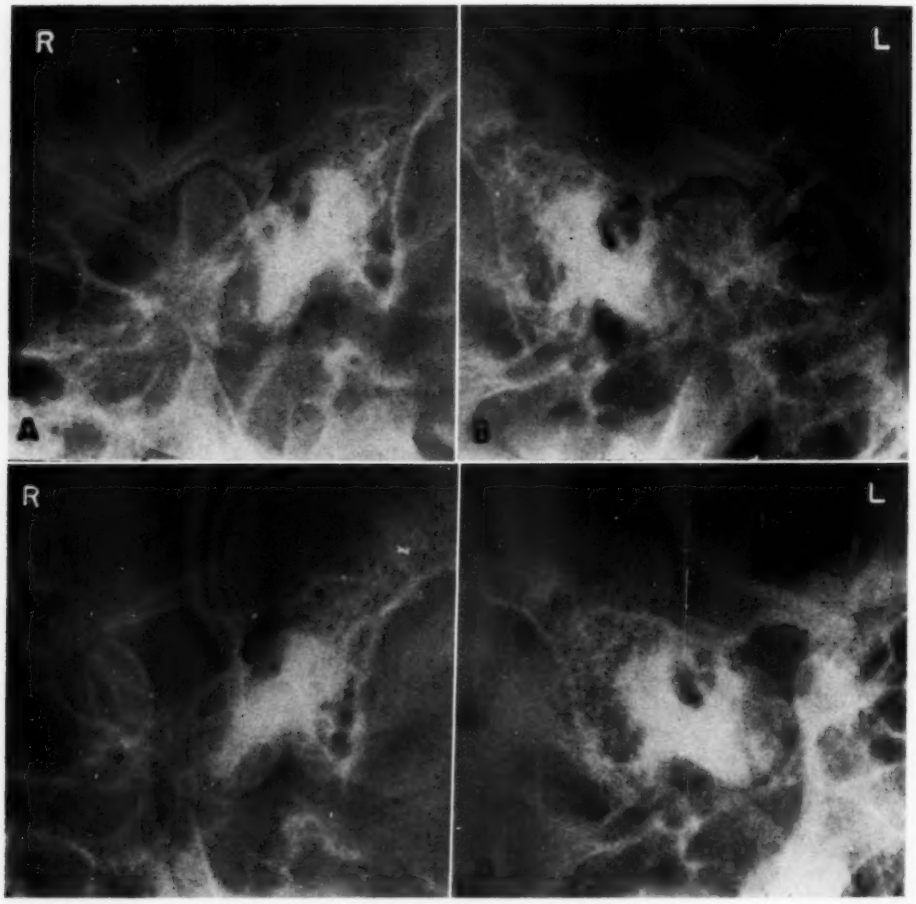

Fig. 2. Case II. (No. 261889): Flattened gliding type joint. Irregularity and clouding of the left joint. Slight restriction of movement. Treated with cork disks, heat, and joint rest.

ROENTGEN CHANGES

The roentgenographic examination shows the anatomic conformation of the joints, which gives a clue to their physiologic movements. We have designated previously the three types: (1) the normal joint, (2) the flattened gliding joint, and (3) the marked convex joint. Roentgenography discloses, also, the width of the joint space, the position of the condyle in the glenoid fossa, and the extent of its mobility, which is demonstrated by films made in the open- and closed-mouth positions.

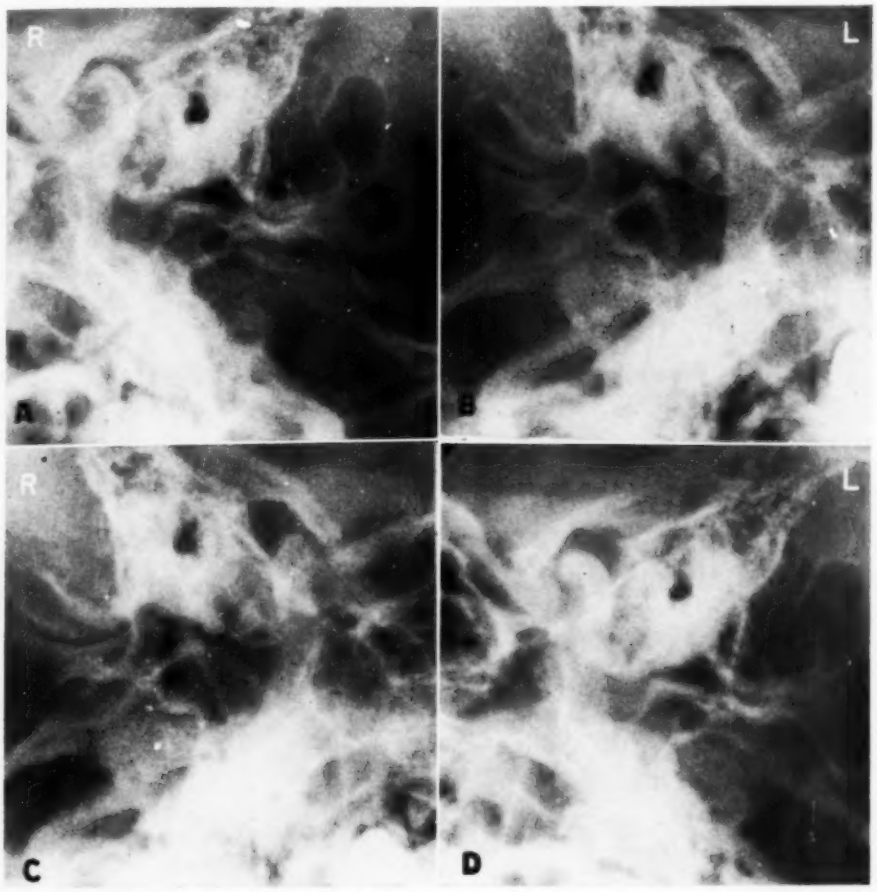

Fig. 3. Case III. (No. 255407): Convex type joint. Pain and clicking of left joint. Abnormal occlusion with closed bite. Left joint narrow and irregular. Treated with bite opening device to relieve abnormal pressure.

Acute Degenerative Joint Disease: Early Changes: (A) Hazing and clouding of the affected joint, with indistinctness of outline of the articular surfaces. This is probably the first change and is caused by abnormal masticating stresses due to malocclusion, either of anatomic type or due to structural changes which alter the usual pressure effects.

(B) Slight narrowing of the joint space with alteration of the position of the condyle, which may be displaced posteriorly and superiorly in the closed position, indicating absorption of the articular cartilage.

(C) In the open position the condyle may be restricted in its anterior extrusion

and be back of the articular eminence, or it may have a wider excursion and move far anterior to the articular eminence, due to relaxation of the ligamentous structures.

Chronic Degenerative Disease: Far-advanced Changes: Chronic degenerative disease is a sequel of the acute degenerative changes, in which there is a diskless joint with loss of normal movement. Recurrent or chronic disarticulation may take place. Hypertrophic changes may be present around the articular margins, with associated flattening and irregularity of the joint surfaces. Loose bodies may be present and there may be marked increased density of the subchondral bone. It is difficult to demonstrate many of these areas of bone production on the film because of the superimposition of other structures, but proper technic will usually disclose these changes.

In those joints with rheumatoid arthritic involvement there is narrowing of the joint space, with involvement of the subchondral bone, and later bony ankylosis. Acute suppurative infection of the joint causes rapid destruction, with secondary bony ankylosis. Ankylosis of the joint from trauma may result from callus formation secondary to old injury. It is usually a slowly developing process and is associated with maldevelopment of the mandible.

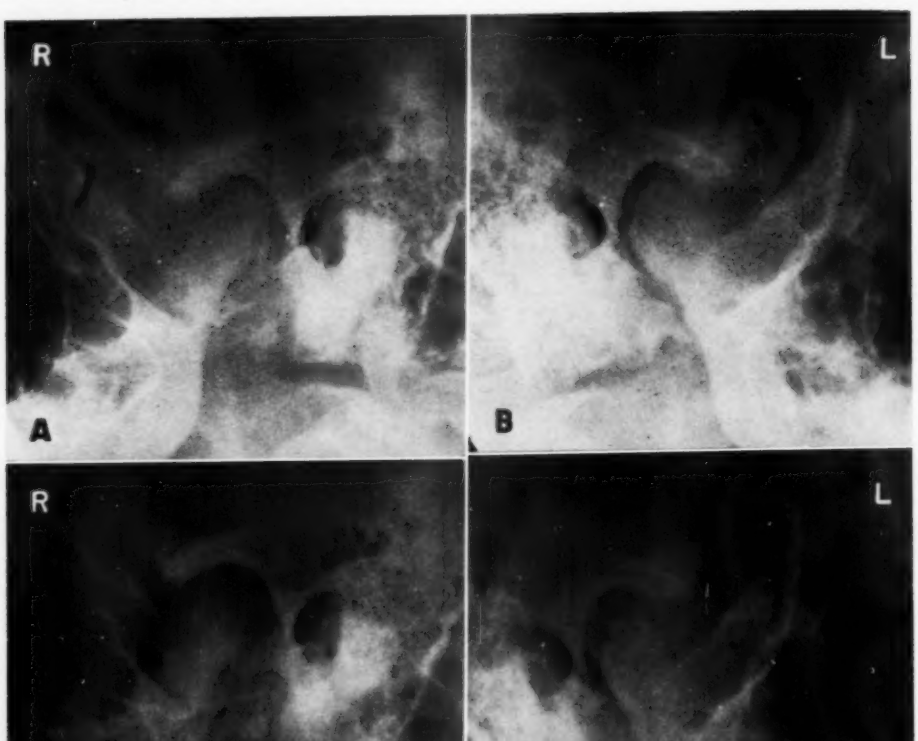

Fig. 4. Case IV. (No. 193611): Patient with generalized arthritis. Clouding of both joint spaces with restriction of movement of the condyles. Unsharpness of bony contours

TREATMENT

No single type of treatment is applicable to all types of cases and frequently it is necessary to institute several different courses of treatment before a clinical cure is obtained. Early acute changes based on a single act of trauma, and other joint changes which have not resulted in permanent damage of the meniscus, usually respond well to conservative treatment. This consists primarily in establishment of comparative rest of the joint by restriction of motion and subsistence on a soft diet. It may be necessary for the patient to restrict opening of the jaw forcibly, with hand pressure, during a yawn. In addition, the use of aspirin at the rate of 30 to 40 grains per day and the application of dry heat supplied by an electric heating pad or infra-red lamp, or better still by short wave diathermy, are valuable adjuncts. Correction of abnormalities in dental occlusion is also of paramount importance. This may consist of restoration of edentulous areas, relief of cuspal interference by judicious occlusal grinding, or actual bite opening by insertion of a bite plane which increases the space between the upper and lower teeth and actually brings the condylar head slightly forward in its excursion.

Failure to obtain relief from such a combination of therapy may indicate either inflammatory changes that have failed to respond to conservative treatment or may well indicate irreversible changes in the meniscus.

X-ray therapy will frequently give palliative relief, reducing inflammation sufficiently to allow correction of dental abnormalities.

Intra-articular injection of hydrocortisone, depositing 0.5 c.c. in each upper and lower joint space, has resulted in a high percentage of apparent cures with almost immediate relief of pain and snapping, cracking or crepitation. Evaluation of this method of therapy is to be reported in the near future.

A relatively small percentage of patients fail to respond to any of the above-described methods of treatment. In these it is evident that irreparable damage has been done to the meniscus. Meniscus shadows indicating partial calcification of this structure may be associated with evidences of either localized osteoporosis or production of osteophytes and can be clearly visualized in a well made roentgenogram.

In such advanced and resistant cases, meniscectomy is the treatment of choice and is almost universally followed by complete relief of symptoms and re-establishment of adequate function. This is done through a pre-auricular incision, with care to keep the incision and dissection well posterior, to eliminate the possibility of seventh nerve damage.

The type of treatment utilized for any given patient depends on clinical and roentgenographic findings and on what has already been done in the form of active treatment. As a general rule, the most conservative measures are carried out first, intra-articular injection and meniscectomy being reserved for the most resistant cases. However, if adequate roentgenographic study reveals evidence of osteoporosis or osteophytes and production of a meniscus shadow, meniscectomy is usually the eventual procedure.

SUMMARY

In this communication we have described the gross anatomy of the temporo-mandibular joints and called attention to the various types which fall within the range of normal. The clinical findings associated with alteration of the morphology and mobility of these joints due to disease and injury have been discussed.

The roentgenographic technic used by us has been described in some detail. The roentgen examination discloses the anatomic conformation of the joints in the open and closed positions, which gives a clue to their physiologic movement and any morphologic changes which have occurred as the result of injury or disease. The common arthritides involve these joints in similar fashion to other joints.

A brief indication of the therapy employed in the treatment of these conditions is included.

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SUMARIO

Estudio Radiológico de las Articulaciones Temporomandibulares

Después de describir la anatomía macroscópica de las articulaciones temporomandibulares, llámase la atención sobre las varias formas que quedan dentro de los límites de lo normal. Discútense los hallazgos clínicos que acompañan a la alteración de la morfología y la movilidad de dichas articulaciones, debido a la enfermedad y al traumatismo.

A fin de poder obtener información exacta por medio de las radiografías, la técnica radiográfica requiere cuidadosa atención a los detalles a la par que la cooperación del enfermo. Varias posiciones resultan útiles. Las radiografías de mayor valor son las tomadas en la posición oblicua lateral, en la cual se observan la relación anteroposterior del cóndilo con la fosa glenoidea y la eminencia articular y el ancho del espacio articular. La proyección posteroanterior es también de valor para observar los tejidos articulares en su relación lateral.

El examen roentgenológico revela la conformación anatómica de las articulaciones en las posiciones abierta y cerrada, lo cual ofrece una indicación de su movilidad fisiológica y de las alteraciones morfológicas que han tenido lugar a consecuencia de la enfermedad o del traumatismo.

Routine Clinical Experiences Using Urokon Sodium 70% in Intravenous Urography[1]

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and

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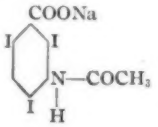
THE INTRODUCTION by Swick (27) in 1929 of excretory urography as a procedure for roentgenographic visualization of the urinary tract has led to improved clinical evaluation of renal function and diagnosis of renal lesions. During the past twenty years many new substances have been used as contrast media for diagnostic roentgenologic technics. This paper reviews our experience with Urokon Sodium 70%, a new contrast medium for excretory urography recently developed in the research laboratory of the Mallinckrodt Chemical Works.

Urokon Sodium 70% is a sodium salt of 3-acetylamino-2,4,6-triiodobenzoic acid. It is reported to have the following structural formula, and to contain 65.8 per cent iodine per molecule (32).



A number of earlier reports on the clinical use of this substance for intravenous injection as a 30 per cent solution for excretory urography indicate a lower incidence of severe side reactions than encountered with other compounds now widely used for the procedure. Pyelograms obtained following the intravenous injection of Urokon Sodium 30% have been said to be at least equal in quality to those obtained with other media (16, 21, 23). There have been a few reports on the clinical trial of Urokon Sodium 70% as a contrast medium for intravenous injection in cardioangiography (9) and translumbar aortography (14). Because of its high iodine content, excellent nephrograms and pyelograms were obtained when the substance was used for excretory urography (31).

TABLE I: RELATIVE IODINE CONTENT IN AVAILABLE CONCENTRATED UROGRAPHIC MEDIA

	Gm. Media/-c.c.	Gm. Iodine/-c.c.	Gm. Iodine/-50 c.c.
Urokon Sodium 70%	0.70	0.4606	23.03
Neo-Iopax 75%	0.75	0.3862	19.31
Diodrast 70%	0.70	0.3486	17.33

Table I indicates the relative iodine content available in concentrated form in three iodinated organic compounds.

ANIMAL EXPERIMENTS

The original pharmacological studies on Urokon Sodium 70% by Seevers (29) indicated an exceedingly low toxicity in the dog and monkey. Porporis and Mueller (20) have carried out some investigations on renal functions in dogs before and after rapid intravenous infusions of Urokon Sodium 70% at high dose levels. One of 3 animals survived a dose level of 5 gm. per kilogram of body weight. Para-aminohippuric acid (PAH) and inulin clearances before Urokon infusions and thirty minutes and twenty-four hours after Urokon infusions, at dose levels of 5 and 2.5 gm. per kilogram are given in Table II.

The results obtained at a dose level of 2.5 gm./kg. parallel those obtained with 4 other animals. PAH clearance thirty minutes following rapid intravenous administration of Urokon Sodium 70% at a dose level of 5 gm./kg. resulted in complete inhibition of tubular secretion of PAH

[1] Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

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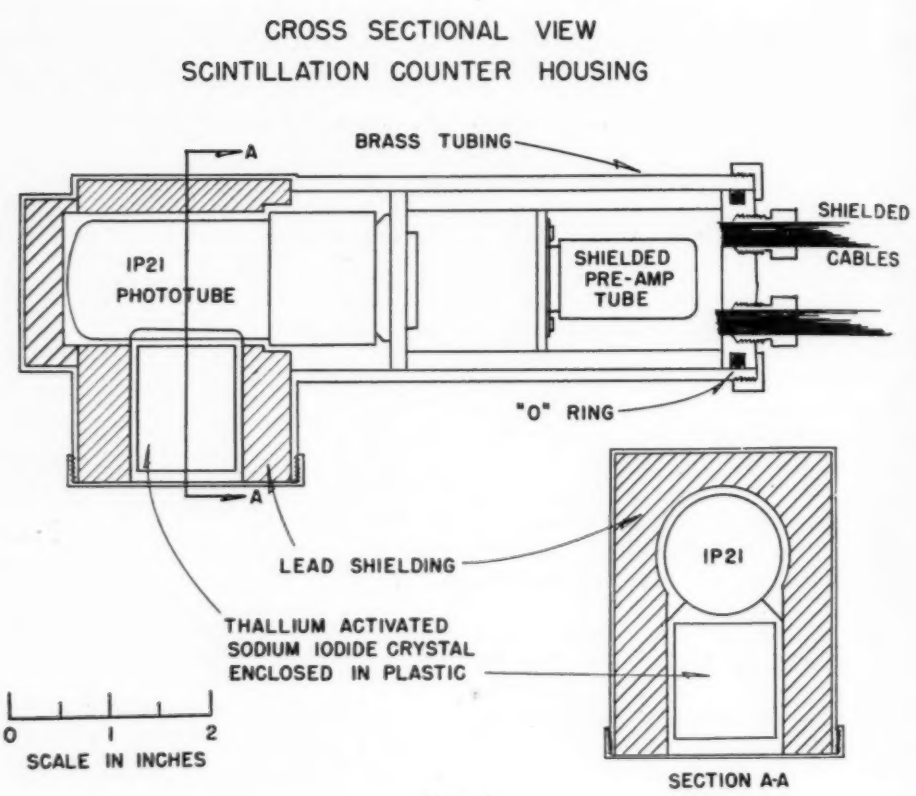

Figure 1

TABLE II: INULIN AND PARA-AMINO-HIPPURIC ACID CLEARANCES FOLLOWING MASSIVE DOSES OF UROKON SODIUM 70%

	Control	30 Minutes after Urokon	24 Hours after Urokon
Dog 1: Dose 5 gm. Urokon 70%/Kg.			
PAH ml./min.	115	28	111
Inulin ml./min.	28	29	30
Filtration fraction	24		28
Dog 1: Dose 2.5 gm. Urokon 70%/Kg.			
PAH ml./min.	100	34	109
Inulin ml./min.	30	25	26
Filtration fraction	30		26
Simultaneous Urokon clearance ml./min.		25	

with no change in the inulin clearance. At a dose level of 2.5 gm./kg. a decrease in tubular secretion of PAH varied between 80 and 100 per cent with no change in inulin clearance. Twenty-four hours after infusion at both of these dose levels, the PAH clearance was normal.

In normal dogs the clearance of Urokon at massive dose levels seems to be approximately that of the inulin clearance, and it is probable that much of the excreted Urokon is essentially a glomerular filtrate.

We believe that the inhibition of tubular secretion of PAH at thirty minutes may represent a competitive action of Urokon Sodium 70% over PAH transport from the peritubular capillaries into and through the renal tubular epithelium.

Repeated large doses in one dog over a period of one month, a total of 9 gm. per kilogram, resulted in no decrease in the ability of the kidneys to clear blood of PAH. Histopathological studies on renal biopsies from 4 dogs following intravenous injections of large doses have shown no evidence of pathological changes attributable to the concentrated contrast medium.

AORTOGRAPHY AND NEPHROGRAPHY

Steinberg and Robb (26), in 1938, first called attention to the opacification of the kidneys following the intravenous injection of 70 per cent Diodrast. Weens, Olnick, James, and Warren (34) and Vesey, Dotter, and Steinberg (30) have used this contrast medium for intravenous aortography and nephrography. The cycle of events following intravenous injection of high concentrations of iodinated organic compounds for opacification of the kidneys has been described as passing through three phases, an arterial phase followed by a capillary phase, giving rise to the maximum radiopacification of normally functioning renal substance, and an excretory phase terminating in the appearance of the contrast medium in the calyces and renal pelvis. Attention has been called to opacification of the spleen which seems to confirm the idea that an immediate nephrogram represents in part, at least, the opacified circulating blood through the renal parenchyma as well as subsequent glomerular filtration and tubular excretion of the contrast medium.

RADIOACTIVE TRACER TECHNIC FOR AORTOGRAPHY

In order to take advantage of the information obtainable from roentgen visualization of the renal blood supply and the opacification of the kidney by concentrated iodinated compounds, it is necessary to precisely time the initial x-ray exposure following intravenous injection of the contrast medium. This can be accomplished by the addition of a suitable radioactive tracer to the contrast medium and recording the presence of radioactivity by a scintillation counter. The method serves to circumvent some of the technical difficulties that have been encountered in carrying out abdominal aortography after intravenous injections.

We are indebted to Dr. Michel Ter-Pogossian for the development of a suitable scintillation counter especially designed for this purpose. The counter consists of a 1P21 R.C.A. photomultiplier tube attached to a cylindrical sodium iodide crystal activated with thallium (Fig. 1). The tube and crystal are collimated by an 8 mm. thick lead envelope. The crystal measures 1 inch in diameter and has a thickness of 1 inch. The photomultiplier tube is connected to a highly regulated high-voltage power supply, an amplifier, a pulse height discriminator, and a counting rate meter, all housed in a single cabinet (Fig. 2). A graphic recorder (Esterline-Angus) with a one MA full-scale milliameter is used to record the initial radioactivity as well as the time of each x-ray exposure of a series of roentgenograms.

Fig. 2. Scintillation counter, electronic circuit housing and graphic recorder.

One tenth millicurie (100 microcuries) of di-iodo-fluoroscein tagged with I^{131} is added to approximately 50 c.c. of Urokon Sodium 70%, which is then injected intravenously according to the technic of Robb and Steinberg (22). Following the rapid injection of the Urokon Sodium 70% mixed with the tracer dose of di-iodo^{131}-fluorescein, the scintillation counter placed over the femoral artery indicates the proper timing for the initial x-ray exposure. The cassette is then changed as rapidly as possible and a second film is exposed to record the opacification of the renal parenchyma during the peak of the capillary phase, and the beginning of renal excretion of the contrast medium. It has been found that conventional roentgenographic equipment may be used, but we recommend a tunnel placed below a self-cocking Bucky diaphragm to facilitate

rapid change of cassettes. Automatic serial roentgenographic equipment has been used for special studies. We believe, however, that a precisely timed abdominal aortogram followed by a single film to record the immediate nephrogram, hepatogram, and lienogram is adequate for most urologic problems in which information regarding renal arterial supply and renal parenchyma are needed to supplement the pyelographic findings. The technic is essentially a refinement of the excretory urographic procedure to obtain nephrograms as described by Wall and Rose (31). We have carried out this type of examination of a total of 189 cases.

Abdominal aortography by intravenous injection of a contrast agent can be carried out with this technic with a reasonable degree of accuracy, safety and simplicity as compared with translumbar aortography. It also provides in addition to satisfactory arteriograms, opacification of the liver, spleen, and kidneys during the capillary phase of the circulating opacified blood to these organs. The resulting nephrogram contributes significant information in the differential diagnosis of renal cortical tumefactions and juxta-renal tumors. A greatly improved pyelogram approaching in quality that usually obtained in retrograde urography is secured in a high percentage of cases. The appearance time of contrast medium in the renal collecting system is prompt, and routine films made five minutes following injection usually show good filling of the renal pelves.

The intensity of the immediate nephrogram decreases simultaneously with the appearance of the medium in the renal pelvis although increased density of the renal shadow persists in each of the routine films at five, ten, and twenty minutes following the injection.

Delayed films of the normal biliary tract at one hour or more following intravenous injection reveal a progressive increase in density of the gallbladder to a maximum at four hours. The degree of opacity compares favorably with those observed in patients who have been examined with the usual oral cholecystographic media, including Priodax and Telepaque. The appearance time and density of the cholecystogram are inversely proportional to renal function, an earlier and denser cholecystogram being seen in patients with diminished renal function.

ROUTINE EXCRETORY UROGRAPHY WITH UROKON SODIUM 70%

Because of the improvement in the quality of anatomical detail of the renal collecting system demonstrated in the preliminary work following intravenous injection of 50 c.c. of Urokon Sodium 70%, decreasing amounts of this substance have been tried in routine excretory urographic examinations. It has been found that 25 c.c. of Urokon Sodium 70% provide a moderate degree of opacification of the renal shadows with marked improvement in the quality of the pyelogram and ureterogram as compared with the use of 30 per cent solutions of this or other contrast media. During the past sixteen months approximately 2,500 excretory urographic examinations have been carried out using Urokon Sodium 70% in dosages of 25 to 65 c.c.

We are indebted to Dr. Alexis Hartmann for the suggestion that dosage should be based upon surface area rather than on body weight. We are using a dose of 15 c.c. of Urokon Sodium 70% per square meter of surface area for routine excretory urography and twice the amount of this dose for intravenous abdominal aortography and nephrography.

PREPARATION AND TECHNIC

We believe it is desirable to dehydrate the patient for a minimum of twelve hours preceding the examination and that catharsis, preferably with castor oil, should be carried out to clear the colon of gas and residual fecal masses that may obscure the urinary tract, particularly in bed patients. Intravenous injections for routine excretory urography are done in the usual way. We do not believe that there is any significant advantage in a slow injection rate, and in-

jections are usually made through a No. 18 needle as rapidly as possible without extravasation. If gross extravasation should occur, as indicated by immediate pain and subcutaneous swelling, we inject 1 c.c. of hyaluronidase (150 T.R.U.) which usually results in prompt relief of pain and avoidance of delayed sequelae.

PYELOGRAMS

Barry and Rose (1), in reviewing 1,160 cases in which Urokon Sodium 70% was used intravenously for routine excretory urography, have attempted to grade the resulting urograms with reference to that quality usually obtained on well-filled retrograde pyelograms. In these 1,160 cases, 381 urograms were equal in quality and 519 were slightly inferior to the retrograde studies; 232 of the urograms were of fair quality and 28 were unsatisfactory.

The factors which determine roentgenographic demonstration of the anatomical detail include density of the contrast medium, distention or filling of the collecting system, and peristaltic activity. In comparison with less concentrated solutions of contrast media now in general use, Urokon Sodium 70% appears to exceed the amount of an iodinated organic compound that normal kidneys can excrete in unit time. Evidence of this is found in the more marked opacification of the renal shadows routinely seen with 25 c.c. of this concentrated compound.

Patients with a large capacity collecting system in one kidney and a small renal pelvis on the opposite side often have a satisfactory pyelogram of the larger pelvis throughout the examination and incomplete distention of the small renal pelvis on one or more of the roentgenograms. We believe that it may be of importance to call attention to the necessity of greater control of the volume of urinary excretion during excretory urography. We are now in the process of carrying out clinical studies designed to modify the technic in order to provide adequate fluid excretion during the period of roentgen examination. Preliminary work seems to indicate that the administration of approximately 100 c.c. of water per square meter of surface area, thirty minutes before the intravenous injection, will insure a better distention of the renal pelvis without significant decrease in the density of the pyelogram.

USE OF ABDOMINAL COMPRESSION

Another method of insuring distention of the renal pelves and upper ureters without administration of increased fluid prior to the roentgen examination is the application of abdominal compression after the five-minute film. When not contraindicated, we use ureteral blocks immediately following the film for differential renal excretion and remove them following the supine film at twenty minutes. The semierect film without blocks is taken to favor complete ureteral visualization and drainage of the renal pelvis.

REACTIONS

In reviewing cases of routine excretory urography using 25 c.c. of Urokon Sodium 70%, Barry and Rose (1) report that 89.5 per cent of 556 cases had no significant reaction. Two of the patients, however, had nausea with emesis, fecal incontinence, and a drop in blood pressure to shock levels, but both recovered promptly following symptomatic and supportive therapy.

Zink (35) reported a series of 350 patients at St. Luke's Hospital who received 70 per cent Urokon for excretory urography with a low incidence of reactions, comparing favorably with that recorded by other observers using Urokon Sodium 30%. In his series 12.3 per cent of the patients presented one or more of the following symptoms: nausea, 9.4 per cent; vomiting, 5.7 per cent; arm pain, 1.4 per cent; urticaria, 1.4 per cent. Mild cyanosis and peripheral shock occurred in 0.29 per cent, wheezing in 0.58 per cent and thrombophlebitis in 0.29 per cent. In this series no appreciable change in the number or type of reactions was noted when 50 c.c. of Urokon Sodium 70% was injected for nephrography.

Transient albuminuria has been noted during the first twenty-four hours in some patients by Barry and Rose (1) and Zink (35).

The following case report is submitted as an example of the severe sympomatology which may be encountered:

G. W.: A 21-year-old student nurse was found to have signs and symptoms of urinary tract infection on a routine health check-up in October 1951. Her blood pressure was recorded as 112/52 mm. Hg. She was referred for an excretory urographic examination on June 21, 1952. Following intravenous injection of 25 c.c. of Urokon Sodium 70%, there was an immediate flush of the skin, and the patient complained of nausea and a desire to void. She was able to co-operate for the routine films, but the skin remained flushed and mottled. Following the fifteen-minute film, she was permitted to void. As she rose from the table she fainted, became rigid, but no convulsive movements occurred. She was flushed and cyanotic. The pulse was weak and the systolic blood pressure could not be obtained. Following supportive treatment with epinephrine, neosynephrin, and benadryl, the systolic pressure was obtained at 60 mm. Hg, gradually rising to 100. The patient continued to complain of headache and appeared flushed and drowsy. A urinalysis at this time showed a specific gravity of 1.060, an acid reaction, albumin three plus, and many casts (not otherwise described). Forty-eight hours later the urine was entirely normal.

The excretory urograms demonstrated opacification of the renal shadows at five and fifteen minutes without contrast material in the renal pelves. The nephrogram at fifteen minutes was quite dense. A film two hours after the intravenous injection furnishes a faint pyelogram, and a very dense cystogram as well as a cholecystogram.

Comment: The roentgenographic findings in this case strongly resemble findings reported by Larrson and Palmlov (13) in rabbit kidneys in shock from loss of blood and exposure.

CASE REPORTS

The following case reports illustrate some of the roentgen findings obtained from intravenous injections of concentrated contrast media for arterionephrography, pyelography, and cholecystography.

Case I. (Figs. 3A, B, C, and D): A 38-year-old white male gave a history of nocturia, cloudy urine and recurrent right upper quadrant tenderness with occasional bouts of sharp pain radiating around the right rib cage to the midaxillary line. Two years prior to admission, a diagnosis of chronic cholecystitis and lithiasis was made, and the patient was subjected to exploration at another hospital. The gallbladder was normal. Calcification in the right kidney was described, and the patient was directed to a urologist.

The admission physical examination and routine laboratory data were negative. The patient was referred for abdominal arterionephropyelography. The scout film revealed irregular calcific densities in the right renal region. The renal outline could not be visualized. The abdominal arteriogram showed a normal left renal artery. A small right renal artery was faintly visualized without an immediate nephrogram on this side. There was a normal nephrogram and pyelogram on the left. The nephrogram on the left showed hypertrophy.

A right nephrectomy was performed. The kidney weighed 38 gm. and measured 8 × 4 × 3 cm. The capsule was thickened and scarred. Small calcific masses were found in the parenchyma. Microscopic examination revealed absence of glomeruli, cystic tubules, and fibrosis. Diagnosis: Hypoplastic kidney with calcification and vascular damage.

Case II. (Figs. 4A, B, C, and D): A 40-year-old white female was admitted to Barnes Hospital with a history of mass in the abdomen of three months duration, chills, and fever with cramping in the left leg of three days duration. Urinalysis on admission revealed a trace of albumin, 3 to 5 granular casts per high power field, and 5 to 15 red blood cells per high power field. The urine was negative for cancer cells. The patient was referred for abdominal arterionephropyelography. On arteriography the renal arteries were normal except for superior displacement of the smaller branches of the left by a large mass occupying the lower pole of the left kidney. There was puddling of opaque material in the renal vessels throughout the tumor. The pyelogram showed deformity of the left pelviocalyceal system. A left nephrectomy was performed. The gross specimen consisted of a kidney and a large pseudolobulated thickly encapsulated mass arising from the lower pole, extending upward and outward to involve approximately three-fourths of the kidney substance. The mass measured 14 × 6 cm. Some areas of the tumor were soft and cystic but others were quite firm. Small hard cartilaginous areas were noted. The tumor contained hemorrhagic necrotic areas, some of which contained fluid. Pathologic diagnosis: Renal-cell carcinoma.

Case III. (Figs. 5A, B, C, and D): A 59-year-old white male gave a one-year history of prostatism. He had no symptoms of renal disease. Physical examination was negative except for hypertension of 170/90. The prostate was moderately enlarged and smooth. An abdominal arterionephropyelogram with 65 c.c. of Urokon Sodium 70% revealed

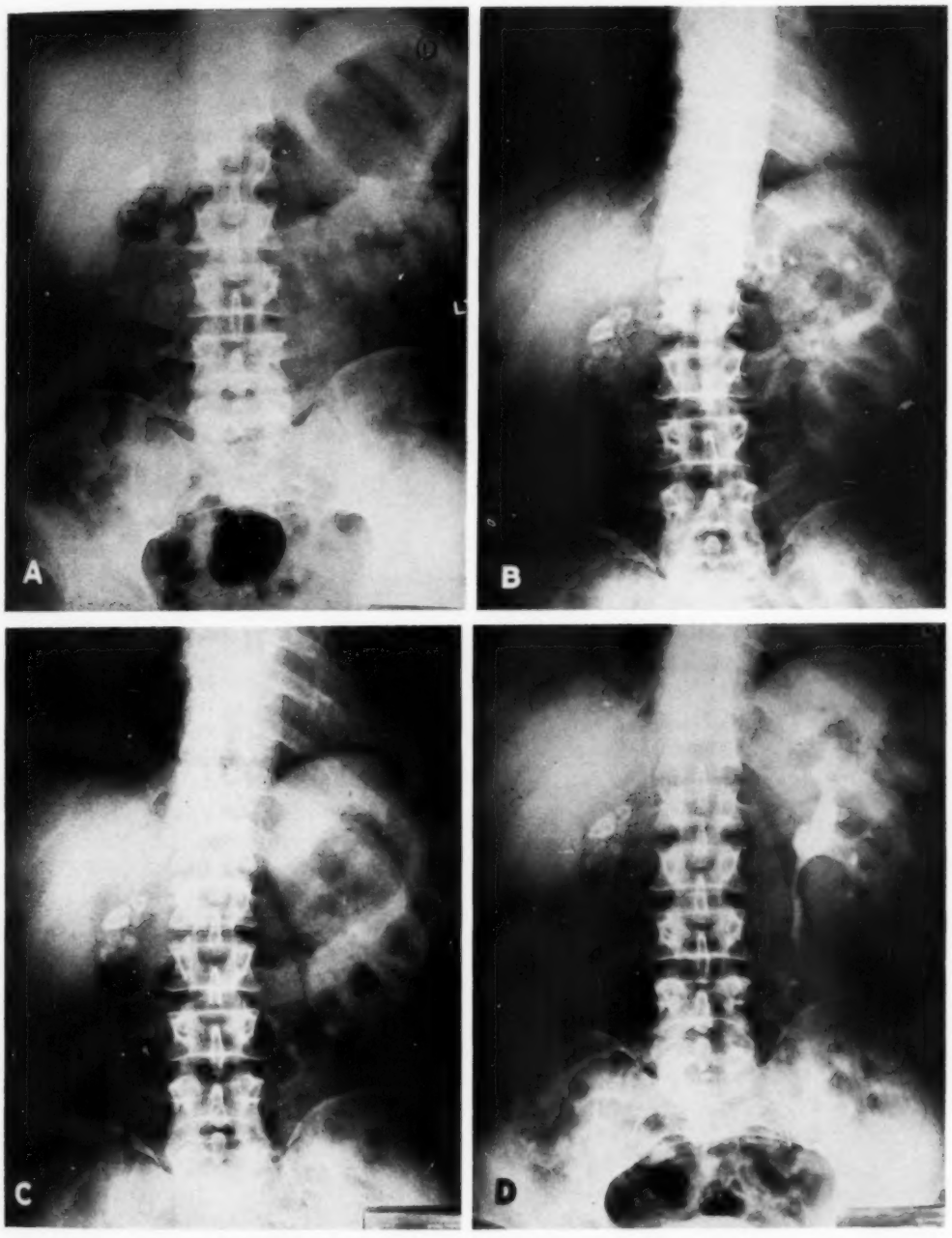

Fig. 3. Case I. A. Scout film, irregular calcific densities in right renal region. B. Intravenous arteriogram, faint visualization of a small right renal artery, two left renal arteries. C. Nephrogram, absence of nephrogram of right kidney. Normal nephrogram of hypertrophied left kidney. D. Left pyelogram at fifteen minutes. No excretory function of the right kidney.

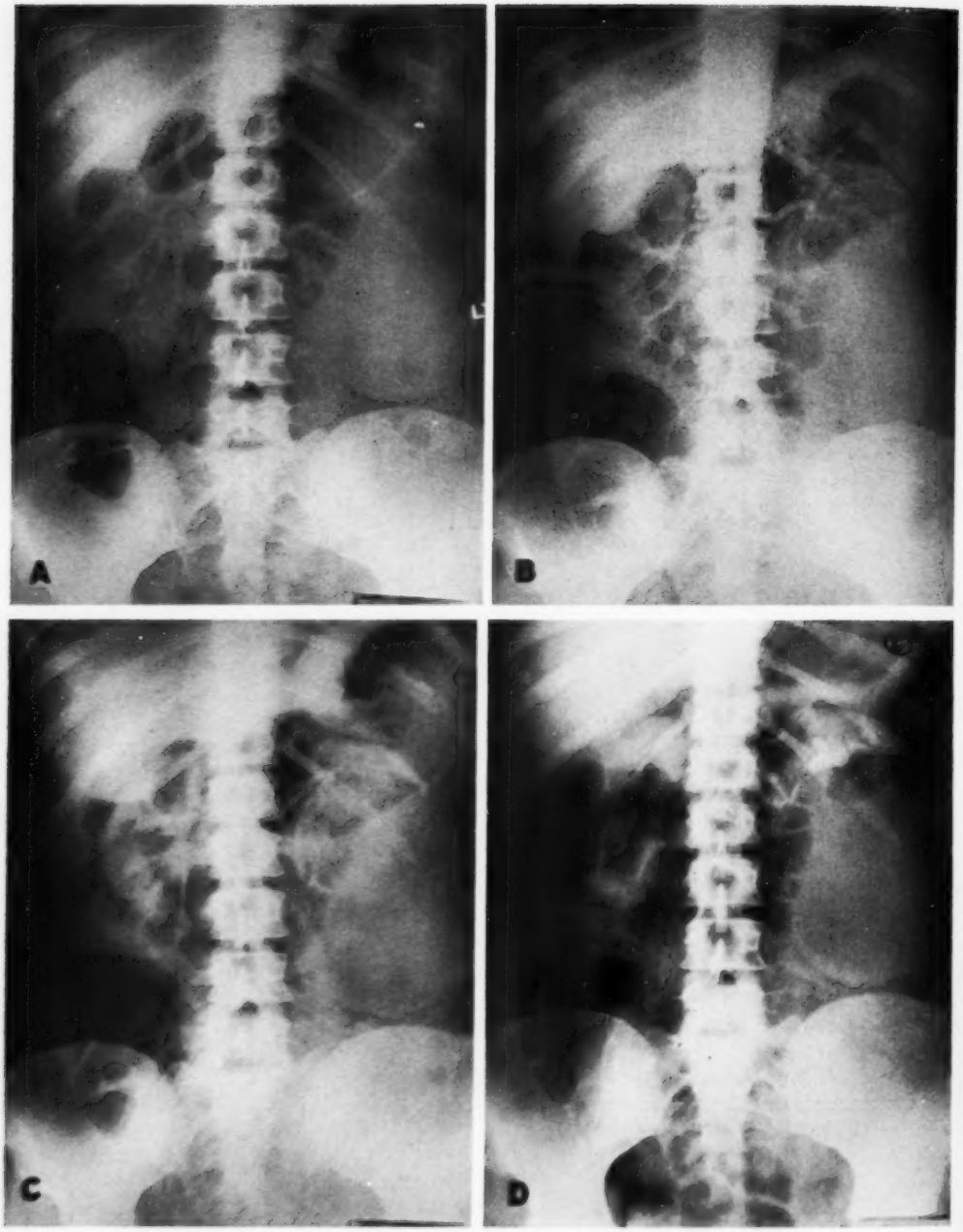

Fig. 4. Case II. A. Scout film shows tumor of the lower pole of the left kidney. B. Intravenous arteriogram showing displacement of the branches of the left renal artery by tumor. C. Left nephrogram shows puddling of opaque material throughout the tumor. D. Deformity of the left pelvio-calyceal system by tumor.

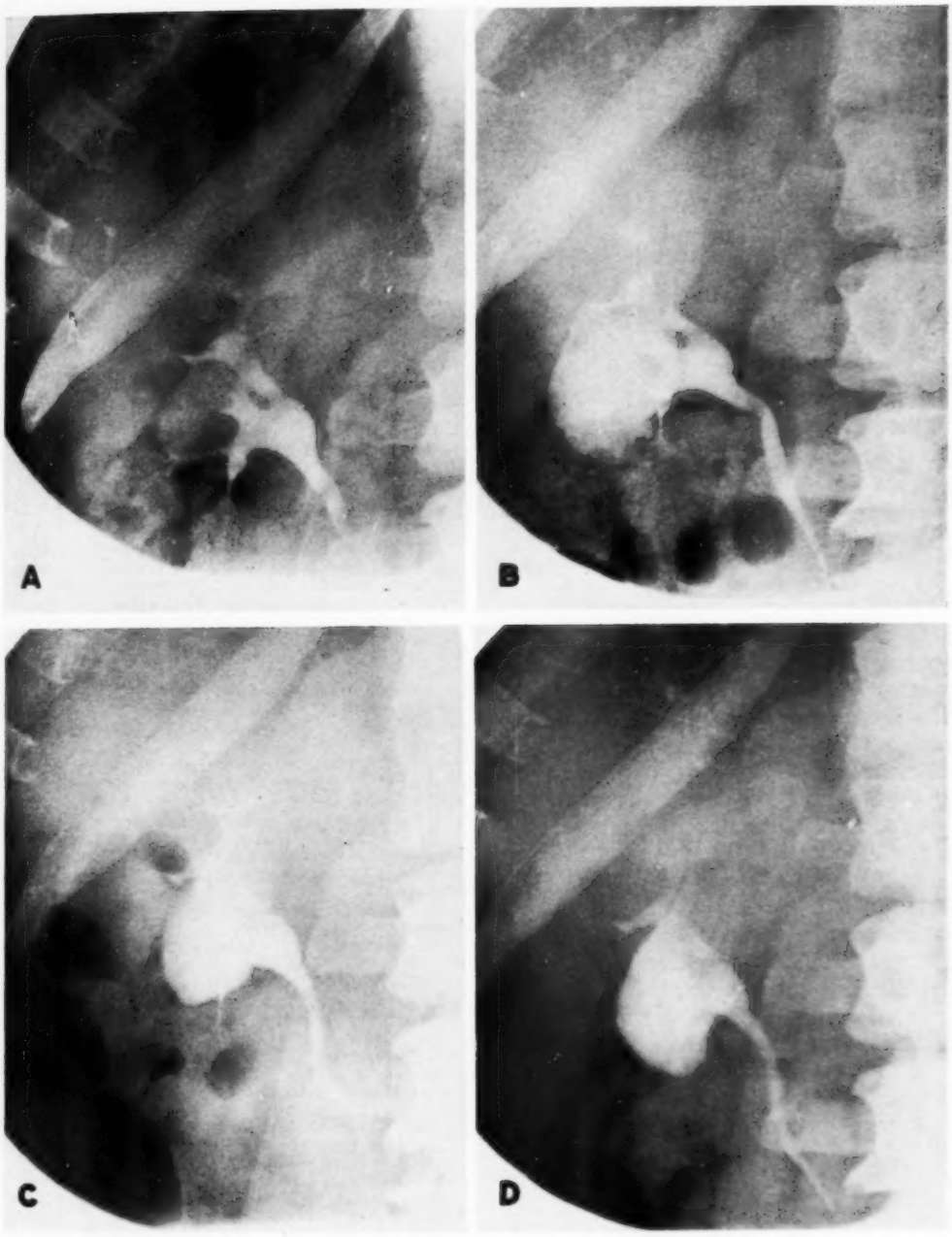

Fig. 5. Case III. A, B, C, and D. Cholecystograms at one hour, two hours and three hours, and five hours after 65 c.c. of Urokon Sodium 70%.

a normal upper urinary tract. A normal gallbladder was visualized at one hour with progressive increase in density of the cholecystograms at two, three, and five and a half hours.

Case IV. (Figs. 6A, B, C, and D): A 24-year-old white male complained of fever, and abdominal and back pain, followed by hematuria of five days duration. Three weeks after the acute episode

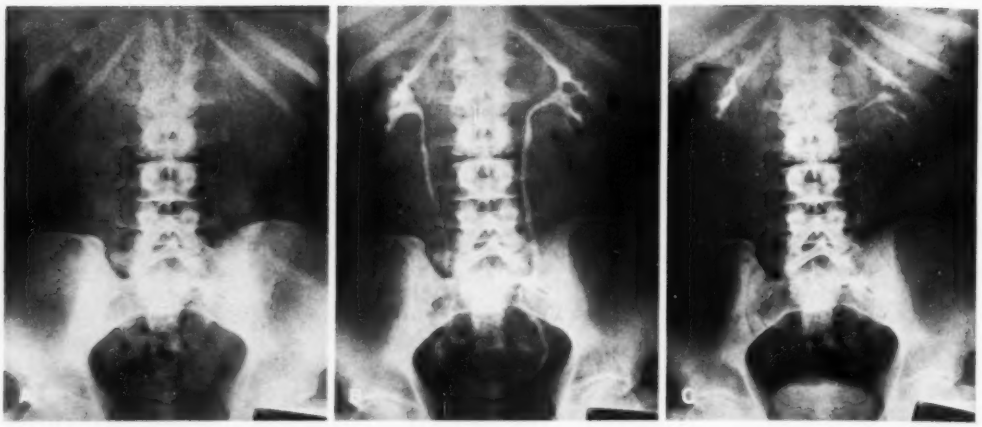

Fig. 6. Case IV. A. Scout film. B. Excretory pyelogram at ten minutes showing moderate increase in renal density after 25 c c. of Urokon Sodium 70%. C. Excretory pyelogram at fifteen minutes, erect film demonstrating decreased distention of renal pelves and good quality cystogram.

excretory pyelograms with 25 c.c. of Urokon Sodium 70% were made. Figs. 6B and C show the quality of the pyelograms at ten and fifteen minutes.

SUMMARY

1. A new contrast medium, Urokon Sodium 70%, has been used for 2,500 routine excretory urographic examinations. The increased iodine content of this substance at a dose level of approximately 25 c.c. results in better nephrograms and urograms than previously obtained with less concentrated iodinated compounds.

2. The roentgenographic contributions from intravenous injection of large doses (50 c.c.) of Urokon Sodium 70% include satisfactory demonstration of the abdominal aorta and its visceral branches, opacification of the liver, spleen, kidneys, gallbladder, as well as excellent urograms and cystograms.

3. A radioactive tracer technic for precise timing of the x-ray exposure for abdominal arteriography after intravenous injection of a concentrated contrast medium is described.

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SUMARIO

Observaciones Clínicas con el Uso del Urokón Sódico en la Urografía Intravenosa

Un nuevo medio de contraste, el Urokón Sódico al 70 por ciento, ha sido usado en 2,500 exámenes urográficos excretorios corrientes. El mayor contenido de yodo en esa substancia a dosis de unos 25 c.c. da por resultado mejores nefrogramas que los obtenidos antes con compuestos yodados menos concentrados.

Descríbese una técnica de despistador radioactivo para fijar precisamente el tiempo de la exposición a los rayos X para la arteriografía abdominal después de la inyección endovenosa de un medio de contraste concentrado. Para ese procedimiento se ha elaborado un espinterómetro adecuado. Añádese un decimilicurie (100 microcuries) de di-yodo-fluoresceína marcada con I^{131} a unos 50 c.c. de Urokón Sódico al 70 por ciento, que luego se inyecta endovenosamente conforme a la técnica de Robb y Steinberg. Después de la rápida inyección del Urokón mezclado con la dosis despistadora de di-yodo^{131}-fluoresceína, el espinterómetro colocado sobre la arteria femoral indica el tiempo apropiado para la exposición inicial a los rayos X. Luego se cambia el chasis con la mayor velocidad posible y se expone otra película para registrar la opacidad del parénquima renal durante el acmé de la fase capilar y el comienzo de la excreción renal del medio de contraste. Puede usarse la instalación roentgenográfica corriente, pero los AA. recomiendan un túnel colocado debajo de un diafragma autoimpulsado de Bucky, para facilitar de esa manera el rápido cambio de chasis.

Con esa técnica, puede llevarse a cabo la aortografía abdominal por medio de la inyección intravenosa de una substancia de contraste, con bastante exactitud, inocuidad y sencillez, comparada con la aortografía translumbar. Suministra también arteriogramas satisfactorios, y opacidad del hígado, del bazo y de los riñones durante la fase capilar de la circulación de la sangre

opaca por dichos órganos. En un porcentaje elevado de los casos, se consiguen pielogramas de calidad semejante a los obtenidos habitualmente con la urografía retrógrada. El tiempo de aparición del medio de contraste en el sistema colector del riñón es rápido y las radiografías tomadas a los cinco minutos de ejecutar la inyección suelen revelar buen henchimiento de las pelvis renales.

DISCUSSION

Fred J. Hodges, M.D. (Ann Arbor, Mich.): It is interesting to reflect that some twenty-seven years ago in the same city where these authors worked, Graham and his associates developed cholecystography and that they were immeasurably aided by the same chemical manufacturing company which has supplied the product that has been described today. One remembers that in the use of isoiodeikon it was hoped that not only could the gallbladder be seen in roentgenograms, but also that the method would be available for determining liver and renal function simultaneously. Today, after a twenty-seven-year interval, we have seen that work has continued to go on in St. Louis with the same manufacturing company and the same medical institution probing more deeply into technics which will enable the radiologist to provide a sizable amount of variegated information from one procedure.

At our institution we are convinced of the safety of this material for intravenous use, having been in contact with the elaborate pharmacological testing done by Seevers. While experience in our hospital has been with the 30 and 50 per cent preparations, for the most part, we have more recently been using the 70 per cent material for cardioangiography with gratifying results. The added density is clearly noticeable. Thus far our clinical experience has not been marred by unusual side-effects as compared with other compounds.

The scintillation counter equipment for accurately determining the optimum time for making nephrograms is certainly ingenious and should be helpful. As yet we haven't provided ourselves with such equipment.

The induced opacity of liver, spleen, and kidneys, as shown to us today, is most interesting and may well have considerable practical utility. Continued chemical research and persistent improvement of radiological apparatus and technics have added to the overall usefulness of radiology in medical practice.

Leo G. Rigler (Minneapolis, Minn.): This has been a very interesting paper to me since we have had a somewhat similar experience except that we haven't done it as well. We have used Urokon 70% in about 500 cases primarily for purposes of intravenous urography and have had the same experience in being able to demonstrate the gallbladder on films made at the proper time. We found it a very satisfactory medium, but, after seeing two very severe reactions, one patient going into a state of shock of very severe character, we have decided that Urokon 30% is a little safer for ordinary intravenous urography despite the fact that it doesn't give quite as satisfactory a visualization, and despite the fact, of course, that the possibility of doing combined gallbladder and intravenous urography is eliminated.

I think that one should hesitate to use a medium that involves any risk for routine procedures. I might say that we have used Urokon 70% in 40 c.c. doses for abdominal aortography, under anesthesia, without any reactions whatever, as one might expect, because in the anesthetic state one doesn't get these shock reactions. It has been an extremely satisfactory medium for that purpose, but of course the material is being introduced directly into the aorta and thus is greatly diluted before getting to the cerebral circulation. I would say that for certain special situations, where some risk has to be taken, such as angiocardiography or abdominal aortography, this is a very satisfactory medium. Since—at least in our hands—the degree of reaction has been entirely different with the 70 per cent than it has with the 30 per cent solution, I would raise the question as to whether one should use it for routine intravenous urography, despite the many advantages which the speaker has so beautifully related.

A Preliminary Report on Teridax,[1] A New Cholecystographic Medium[2]

ROBERT SHAPIRO, M.D.

New Haven, Conn.

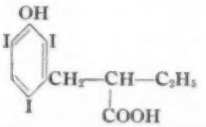
NUMEROUS INVESTIGATORS agree that the ideal cholecystographic medium should fulfill the following requirements: (1) low systemic toxicity and minimal unpleasant side reactions; (2) ease of administration; (3) ready elimination; (4) selective localization within the gallbladder; (5) preferential renal excretion, to eliminate confusing opaque bowel shadows; (6) the optimal degree of density to provide adequate visualization and yet not obscure stones.

Tetrabromphenolphthalein, the original compound, was soon replaced by its iodine homologue which was in turn supplanted by iodoalphionic acid (Priodax) in 1940. Priodax has proved to be a very satisfactory contrast substance but unfortunately has a significantly high degree of unpleasant side effects, particularly diarrhea. In various reports from the literature, the diarrhea ranged from 2 per cent to 43 per cent (3, 4, 5). In one of the author's unpublished studies with Priodax, the incidence of diarrhea was 30 per cent, with severe diarrhea in 8 per cent of the cases.

In 1951, a new cholecystographic medium, iodopanoic acid (Telepaque) was introduced (1, 2). This is superior to Priodax in several respects: (1) The increased density of the gallbladder shadow results in better visualization, and fewer repeat examinations are required. (2) Fewer unpleasant side reactions occur. (3) There is frequent visualization of the extrahepatic biliary ducts. Telepaque, however, has the disadvantage of being excreted through the bowel. In addition, the opacification of the gallbladder is frequently so great that it is possible for stones occasionally to be obscured by the medium.

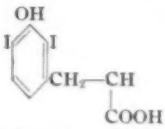
In an effort to obviate the shortcomings of Telepaque, a new compound, ethyl triiodoalphionic acid (Teridax) has been synthesized. Teridax is excreted principally by the kidneys and produces a gallbladder shadow which is intermediate in density between that produced by Priodax and Telepaque. In addition, it has the same low level of side reactions as Telepaque. The close chemical relationship of these three substances can readily be ascertained by inspection of their structural formulae.

Teridax
66.5% iodine



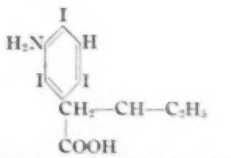
α Ethyl β-(2,4,6 triiodo-3-hydroxyphenyl) Propionic Acid

Priodax
51.4% iodine



β-(4 hydroxy-3,5-diiodophenyl)-α phenyl Propionic Acid

Telepaque
66.7% iodine



3-(3 Amino-2,4,6 triiodophenyl)-2-Ethyl Propionic Acid

CHEMICAL AND PHYSICAL PROPERTIES

Teridax is a white, odorless, crystalline powder which contains 66.5 per cent iodine, has a molecular weight of 572, and melts sharply at 143–144° C. It is almost insoluble in water but is soluble in methyl and ethyl alcohol and other organic solvents (6).

[1] Trade Mark. Teridax was kindly supplied by the Division of Clinical Research, Schering Corporation, Bloomfield, N. J.

[2] From the Departments of Radiology of the Hospital of St. Raphael and The Yale University School of Medicine, New Haven, Conn. Accepted for publication in January 1953.

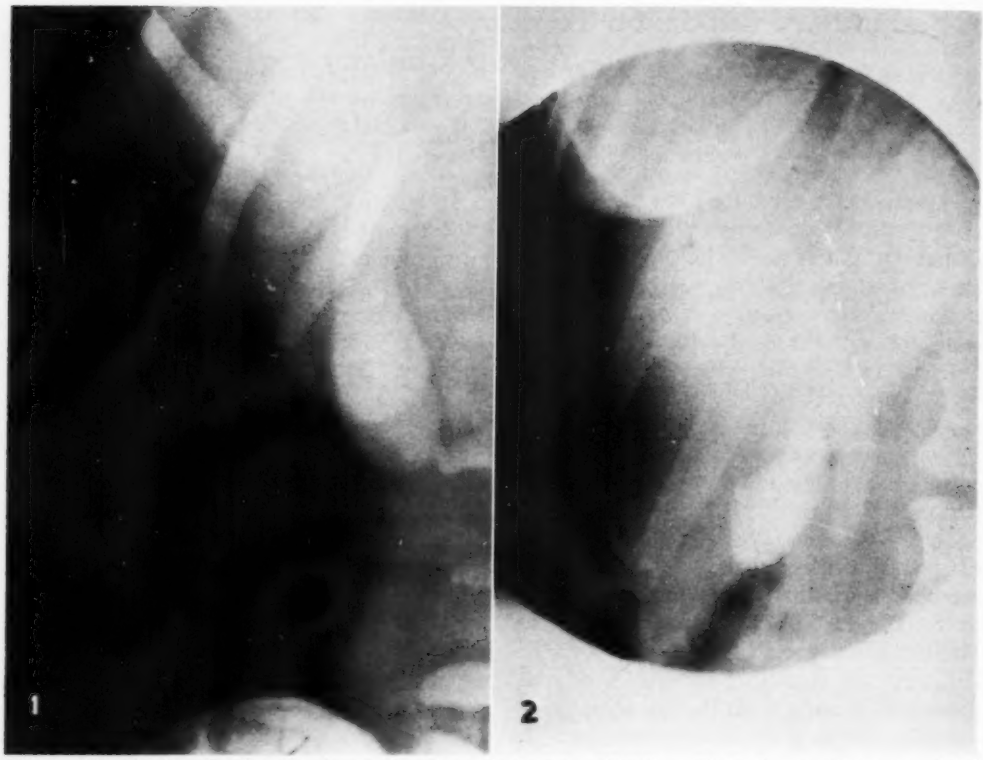


Fig. 1. Visualization of gallbladder four hours after oral ingestion of Teridax. Note absence of opaque material in colon.
Fig. 2. Cholecystogram showing duct visualization 20 minutes p.c.d.

PHARMACOLOGY

Mode of Elimination: In experimental animals and in man, oral Teridax is eliminated principally by the kidneys and to a very minor extent by the gastrointestinal tract. The similarity of Teridax to iodoalphionic acid in this respect is advantageous since masking of the gallbladder by radiopaque material in the colon does not occur.

Time of Visualization: In man, Teridax begins to concentrate in the gallbladder within four hours following oral administration (Fig. 1). Maximal concentration is reached between eight and twelve hours. Teridax is more slowly excreted than iodopanoic acid. Thus, it is not uncommon to find opacification of the gallbladder forty-eight hours after ingestion of the compound. Rapid contraction of the gallbladder takes place with Teridax, however, following the administration of a fatty meal. The majority of normal gallbladders contract satisfactorily within twenty to thirty minutes after stimulation by a fatty meal.

Toxicity: In acute oral toxicity studies in mice, the LD 50 value for Teridax was 1,850 mg./kg. as compared to 2,950 mg./kg. for iodoalphionic acid and 5,120 mg./kg. for iodopanoic acid. The LD 50 value in the rat was found to be 2,000 mg./kg. for Teridax.

In acute intraperitoneal toxicity studies in mice the LD 50 value for Teridax was 440 mg./kg. as compared to 720 mg./kg. for iodoalphionic acid. Similar values were obtained in other species. Thus, in the rat, the LD 50 value for Teridax was 648 mg./kg., while in the guinea-pig it was 570 mg./kg. These figures are to be com-

pared with values for iodoalphionic acid of 650 mg./kg. and 800 mg./kg. in the rat and guinea-pig respectively.

In acute intravenous toxicity studies in dogs, the lethal dose for Teridax ranged between 265 mg./kg. and 602 mg./kg. with an average of 454 mg./kg. No significant changes in blood pressure or respiration were observed until approximately one-half of the infusion had been given. Thereafter, a gradual decline in respirations and pulse rates occurred.

In five-week oral subacute toxicity studies in mice, the mortality was 8/15 at the 900 mg./kg. dose, 3/15 at the 600 mg./kg. dose, 0/15 at the 300 mg./kg. dose, and 0/15 at the control level. The mean body weights were normal for the compound fed animals and the controls except for a slight retardation of growth for the animals on the 900 mg./kg./day dose.

Just prior to autopsy, blood determinations were made. The white blood cell, red blood cell and hemoglobin values were normal for the treated mice and for the controls. After five weeks of treatment, autopsies were performed on the animals. Gross examination of the organs revealed no pathological changes. Detailed histologic studies showed no changes in the liver, kidneys, spleen, heart, adrenals, thymus, or testes which could be attributed to the compound.

CLINICAL DATA

In a series of 225 patients, the gallbladder was visualized on the first examination in 184 (81.8 per cent) following the administration of Teridax. Re-examination on the following day with Teridax or iodopanoic acid resulted in visualization of the gallbladder in 10 additional cases (4.4 per cent), making a total of 86.2 per cent visualized. There were 31 patients (13.8 per cent) whose gallbladders failed to visualize at all after two consecutive attempts with Teridax or iodopanoic acid. Of the latter group, 9 had cholecystectomies with confirmation of the radiographic findings, 5 had obvious opaque gallstones on the preliminary film, 1 had an old cholecystojejunostomy, and 16 have not been operated upon to date.

VISUALIZATION OF THE GALLBLADDER WITH TERIDAX

Nonvisualization	31 (13.8%)
Total number visualized	194 (86.2%)
Good or excellent	148 (76.3%)
Fair	29 (14.9%)
Poor	17 (8.8%)

In general, the gallbladder shadows following Teridax were denser than those ordinarily obtained with iodoalphionic acid but were not quite so dense as those obtained with iodopanoic acid. The intermediate density of the gallbladder shadow with Teridax is probably advantageous in demonstrating occasional stones that might be obscured by media producing extremely dense shadows.

Frequently visualization of the cystic and common ducts was observed approximately twenty to thirty minutes after ingestion of a fatty meal. The density of the duct shadows, however, is less than that obtained with iodopanoic acid (Fig. 2).

Teridax is well tolerated by patients. Side reactions are much less pronounced than with iodoalphionic acid and are of the same order of magnitude as with iodopanoic acid.

SIDE EFFECTS WITH 3 GM. OF TERIDAX

Total no. patients examined	204
Total no. examinations	240
No symptoms	186 (77.5%)
Nausea	
Slight	15 (6.3%)
Moderate	1 (0.4%)
TOTAL	16 (6.7%)
Vomiting	
Slight	6 (2.5%)
Moderate	2 (0.8%)
TOTAL	8 (3.3%)
Abdominal discomfort	5 (2.1%)
Headaches and dizziness	1 (0.4%)
Allergic skin reactions	2 (0.8%)
Dysuria	3 (1.3%)
Diarrhea	
Slight (1–2 loose stools)	17 (7.1%)*
Moderate (3 loose stools)	3 (1.2%)
Severe (4 or more loose stools)	6 (2.5%)
TOTAL	26 (10.8%)

* One loose stool was considered to represent diarrhea in this study. There were 7 such patients. If these are excluded, the total incidence of diarrhea for the group is 7.9 per cent.

SUMMARY

Teridax is a new cholecystographic medium with low systemic toxicity and a low level of unpleasant side reactions. It is rapidly absorbed from the intestinal tract and is excreted principally by the kidneys.

Teridax produces a gallbladder density intermediate between Priodax and Telepaque.

The extra-hepatic biliary ducts are frequently visualized following the administration of Teridax.

NOTE: The author is deeply indebted to Drs. Norman Hemingway and Dominick Papa for their interest and untiring assistance, and to Dr. S. Margolin for the animal toxicity studies.

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SUMARIO

Informe Preliminar sobre el Teridax, Nuevo Medio para la Colecistografía

El Teridax es un nuevo medio colecistográfico dotado de poca toxicidad orgánica y poca capacidad para producir reacciones subsidiarias adversas. Absórbese rápidamente en el tubo intestinal y se excreta principalmente por los riñones. En una serie de 225 enfermos, se visualizó la vesícula biliar en el primer examen en 184 (81.8 por ciento). El segundo examen al día siguiente con Teridax o ácido yodopanoico reveló la vesícula biliar en 10 casos más (4.4 por ciento), dando un total de 86.2 por ciento de casos visualizados.

En general, las sombras colecistográficas consecutivas al uso de Teridaz fueron más densas que las obtenidas ordinariamente con el ácido yodoalfiónico, pero no tan densas como las obtenidas con el ácido yodopanoico. La densidad intermedia de la imagen de la vesícula biliar con Teridax es probablemente ventajosa para descubrir cálculos ocasionales que quizás quedarían eclipsados por substancias de contraste que produjeran sombras sumamente densas.

Observóse con frecuencia visualización del conducto cístico y del colédoco de veinte a treinta minutos después de ingerir una comida grasa.

El Teridax os tolerado bien por los enfermos. Las reacciones subsidiarias son mucho menos pronunciadas que con el ácido yodoalfiónico y se encuentran en el mismo orden de magnitud que las producidas por el ácido yodopanoico.

Contrast Substances for Angiocardiography

Study of Side Effects[1]

CHARLES T. DOTTER, M.D., MARTIN S. WETCHLER, M.D., and ISRAEL STEINBERG, M.D.

DURING THE fifteen years since Robb and Steinberg boiled commercially available 35 per cent Diodrast to achieve a concentrated contrast solution for angiocardiography (1) many radiopaque agents have been employed for this purpose. In the United States, there has been widespread clinical use of Diodrast 70 per cent (2) and Neo-Iopax 75 per cent (3). The authors have had considerable angiocardiographic experience with these substances (the synonyms of which are given in Table I) and also with Urokon Sodium 70 per cent (4). It is the purpose of this communication to discuss these contrast agents with reference to the side effects related to their angiocardiographic use.

Regardless of the contrast substance employed, angiocardiography results in a profound physical and, therefore, emotional experience for the patient. An attempt was made to assess the nature of the immediate reaction in patients undergoing angiocardiography. Shortly following each injection, co-operative adult patients answered a questionnaire given by a physician (who was unaware of the medium employed). Diodrast, Neo-Iopax and Urokon in concentrated solutions were each used in 25 examinations, consisting of two injections of the usual 40 to 50 c.c. dose of the agent about fifteen to twenty minutes apart. For purposes of estimating the incidence of vascular thrombosis, only patients in whom a "clean" percutaneous insertion of the needle had been made and in whom a one week follow-up inspection was possible were accepted for the study. Details of the immediate reactions to the three drugs are presented in Table II; certain general response patterns became apparent and are discussed individually.

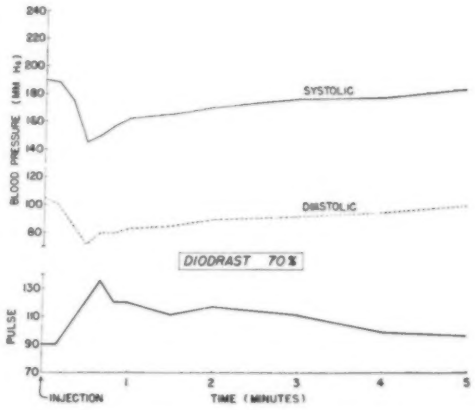

Fig. 1A. Blood pressure during angiocardiography with Diodrast. Patient, a 45-year-old male, had mild essential hypertension without symptoms or cardiac enlargement. Chart shows the blood pressure (recorded manometrically from indwelling femoral arterial needle) fall occurring immediately after the intravenous injection (in 1.5 seconds time) of 50 c.c. Diodrast (70 per cent). Hypotension was accompanied by a sensation of profound weakness.

IMMEDIATE REACTION TO ANGIOCARDIOGRAPHIC USE OF DIODRAST (2, 4)

Starting at eight to twelve seconds after the beginning of the injection, there occurs an intense sensation of heat in the thorax, face, and head which sweeps downward over the entire body, usually including the rectum and genitalia. The feeling of heat over the body apparently indicates the arrival of the contrast agent in the capillary bed. That it involves peripheral vasodilatation is evidenced by the accompanying flush. In the words of a physician who underwent angiocardiography, "One feels like a balloon and the entire body seems to be on fire" (5). A metallic or bitter taste is often noted in the mouth. The sensation of heat reaches a maximum in about fifteen to thirty seconds and di-

[1] From the Departments of Radiology of the University of Oregon Medical School, Hospitals and Clinics and The New York Hospital—Cornell Medical Center. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

TABLE I. DRUGS AVAILABLE FOR ANGIOCARDIOGRAPHY IN THE UNITED STATES

Drug	Diodrast*	Neo-Iopax†	Urokon Sodium‡
Generic name	Iodopyracet	Sodium Iodomethamate	Sodium Acetrizoate
Chemical name	3,5-diiodo-4-pyridone-N-acetic acid diethanolamine	Disodium N-methyl-3,5-diiodo-chelidamate	Sodium 3-acetylamino-2,4,6-triiodobenzoate
Per cent I_2 (dry compound)	49.8	51.5	65.8
Concentration of drug used for angiocardiography (water solution)	70%	75%	70%
Synonyms	Diodone Nosydrast Nosylan Perabrodil Pyelosil Pylumbrin Neoskiodan Umbradil Neo-tenebryl Uriodon Perurdil Vasiodone	Neo-Iopax R Neo-Iopax Sodium Iodoxyl D-40 Pyelectan Uropac Urotrast Uroselectan B Urumbrin	

* Trademark, Winthrop-Stearns, Inc.
† Trademark, Schering Corporation.
‡ Trademark, Mallinckrodt Chemical Works.

minishes during the next few minutes. Weakness is the next most prominent symptom and usually outlasts the feeling of heat. Manometric blood pressure studies made on a patient who received one injection of each of the three agents suggest that the weakness associated with Diodrast is at least temporarily associated with a fall in blood pressure (Fig. 1A). This is in accord with published clinical and experimental investigations (2, 4, 6, 7). In the present series of 25 cases, prominent features of the reaction to Diodrast included heat (100 per cent), weakness (88 per cent), flush (72 per cent), nausea (64 per cent), thirst (60 per cent), and a tendency to coughing (60 per cent). Vomiting occurred in 20 per cent and urticaria in 24 per cent. Arm pain was mentioned only once. One patient was not included in the series since syncope followed the first injection of Diodrast and precluded further injections. Otherwise syncope did not occur during the course of this study. In our total experience of 771 injections (in 540 patients) of Diodrast for angiocardiography, death has not occurred. Syncope, when it took place, was always relieved promptly by adoption of the recumbent posture. We once observed transient partial hemiplegia occurring ten hours following angiocardiography with Diodrast. In another patient, hypotension persisted for six to eight hours following the examination but there was no evidence of impaired renal function and recovery was spontaneous. Angiocardiographic mortality and local vascular sequelae are discussed elsewhere in this report.

IMMEDIATE REACTION TO ANGIOCARDIOGRAPHIC USE OF NEO-IOPAX (3, 4)

The sensations of heat and weakness following the angiocardiographic use of Neo-Iopax are generally milder than those associated with Diodrast. A prominent symptom consists of a throbbing headache (80 per cent) beginning twenty to forty seconds after the injection. This may be of severe intensity. Blood pressure studies (Fig. 1B) reveal this to occur concomitantly with a sudden elevation of systolic and pulse pressures, indicating a possible mechanism for the headache. The headache gradually subsides during the succeeding five to fifteen minutes. Another feature of the immediate response

to Neo-Iopax is a tendency to cough at about six to eight seconds following the injection. Although similar in incidence to the coughing associated with the other drugs (Neo-Iopax 60 per cent, Diodrast 60 per cent, Urokon 44 per cent), the cough with Neo-Iopax is more severe and

TABLE II. COMPARISON OF IMMEDIATE REACTIONS ASSOCIATED WITH ANGIOCARDIOGRAPHIC USE OF DIODRAST, NEO-IOPAX, AND UROKON SODIUM. PERCENTAGES BASED UPON THREE GROUPS OF 25 PATIENTS, EACH OF WHOM RECEIVED TWO INJECTIONS OF ONE OF THE THREE DRUGS

Reaction	Diodrast (%)	Neo-Iopax (%)	Urokon Sodium (%)
Heat	100	92	100
Weakness	88	72	80
Headache	56	80	32
Nausea	64	36	40
Vomiting	20	16	12
Coughing	60	60	44
Thirst	60	84	72
Urticaria	24	8	20
Arm pain	4	24	20
Flush	72	80	68
Pallor	44	44	28
Wheezing	4	4	4
Sneezing	0	0	4
Itching	20	4	24
Palpitations	24	20	24

earlier in appearance. It can usually be controlled by the co-operative patient but, if unrepressed, may by virtue of movement impair the quality of left heart detail. This cough response is abolished by general anesthesia but not significantly altered by codeine. Transient arm pain along the course of the injected vein was noted in 24 per cent of the patients studied (Diodrast 4 per cent, Urokon 20 per cent) and appeared to be more common when there was obstruction of the veins leading to the heart. The pain may be related to transient venous spasm. Most patients (84 per cent) who received Neo-Iopax experienced a sensation of moderate to severe thirst. Urticaria was less commonly encountered (8 per cent) than with either Diodrast (24 per cent) or Urokon (20 per cent), and in no case warranted the use of epinephrine. Table II presents other features of the immediate reaction to Neo-Iopax. We have employed Neo-Iopax for 1,118 angiocardiographic injections in 740 patients without fatality. In one elderly

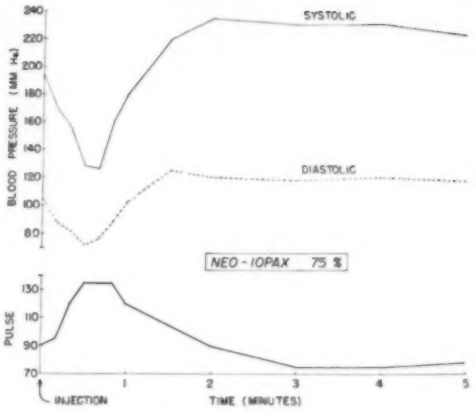

Fig. 1B. Blood pressure during angiocardiography with Neo-Iopax. Same patient as in Fig. 1A. Injection of 50 c.c. Neo-Iopax (75 per cent) done thirty minutes after injection of Diodrast. The elevation of systolic and pulse pressures coincided with a severe throbbing frontal headache.

patient transient facial paralysis and personality changes following angiocardiography with Neo-Iopax suggested that cerebral anoxia may have occurred. Recurrent spasmodic abdominal pain has been observed during the first few hours following angiocardiography with both Neo-Iopax and Diodrast but this has been rare and required no therapeutic measures.

IMMEDIATE REACTION TO ANGIOCARDIOGRAPHIC USE OF UROKON SODIUM (4, 8, 9)

A sensation of heat which is milder than that accompanying the use of Diodrast is always experienced following the injection of Urokon Sodium. Weakness is common (80 per cent). Headache is relatively uncommon (32 per cent) and is not as marked in intensity as with Neo-Iopax. With respect to the blood pressure, neither diastolic hypotension (as with Diodrast) nor systolic hypertension (as with Neo-Iopax) was found to be pronounced (Fig. 1C). Since blood pressure records were only obtained in one case, sweeping conclusions are obviously unwarranted. The blood pressure findings following the use of Diodrast and Neo-Iopax are in accord with other published clinical and experimental observations (2, 4, 6, 7). Other features of the immediate response

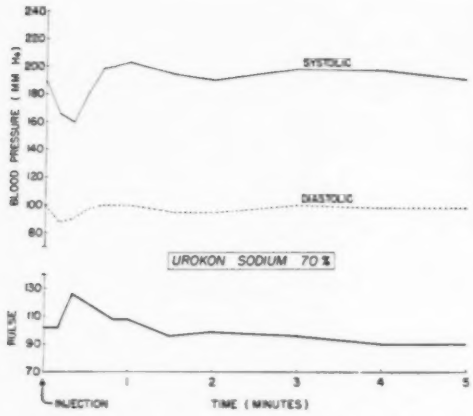

Fig. 1C. Blood pressure during angiocardiography with Urokon Sodium. Same patient, injection of 50 c.c. Urokon Sodium (70 per cent) made thirty minutes after injection of Neo-Iopax. Blood pressure changes less marked than in either previous response. Simultaneous electrocardiograms showed no significant changes with any of the three drugs. Patient stated that the reaction to Urokon Sodium was mildest of the three.

to Urokon (Table II) included: thirst (72 per cent), flush (68 per cent), coughing (44 per cent), nausea (40 per cent), and vomiting (12 per cent). In our total experience with Urokon for angiocardiography, consisting of 780 injections in 453 patients, death or serious complications did not occur.

LOCAL VASCULAR SEQUELAE

The high incidence of thrombosis of the vein injected during angiocardiography is probably related to two principal factors: (1) the great local intravenous pressure generated and (2) the chemically irritant nature of contrast agents employed. The rapid injection of 50 c.c. of saline into an antecubita vein in an adult subject (Fig. 2) resulted in a pressure elevation which attained a maximum of 300 mm. Hg and lasted for the duration of the injection, one second. Sudden vascular distention is shown in a rapid sequence of roentgenograms of the arm made during an angiocardiographic injection (Fig. 3). It is reasonable to assume that minute quantities of the contrast solution are thereby forced through the endothelium into the vein wall, thus setting up an inflammatory invitation for subsequent thrombus formation. Studies by means of cardiac catheterization have indicated that the injection pressure-elevation is dissipated in the large veins of the thorax. Right atrial pressure did not rise significantly during the rapid "angiocardiographic" administration of saline to adults (4).

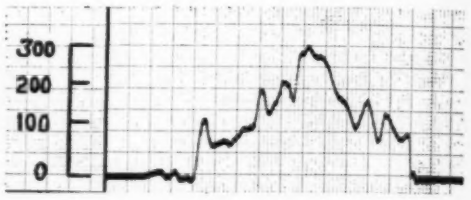

Fig. 2. Angiocardiographic injection, pressure study. Fifty c.c. of saline injected into the median antecubital vein of an adult. Pressure record (in mm. Hg) manometrically obtained from 26 gauge needle inserted into (but not occluding) vein 4 cm. proximal to end of angiocardiographic needle. Intravenous pressure rises sharply during the injection, reaching a height of 300 mm., approximately double the usual arterial systolic pressure.

Regardless of its cause, thrombosis of the injected vein usually follows angiocardiography. In order to assess its incidence one week follow-up examinations were made in three groups of 25 patients, each of whom had received two injections of either Diodrast, Neo-Iopax, or Urokon. No case was accepted for this study unless a "clean" percutaneous insertion of the angiocardiographic needle had been accomplished. Multiple punctures, through-and-through insertions and cut-downs increase the vascular trauma and predispose to thrombosis.[2] Follow-up examinations were made in a fourth group of 25 patients, similarly selected, who had received only a single injection of Urokon.

The results (Table III) are impressive. In the 75 patients who had received two injections of contrast substance, thrombosis occurred sixty times (an incidence of 80 per cent). When only one injection of

[2] During angiocardiography in 1,000 consecutive patients studied at The New York Hospital, percutaneous needle insertion was accomplished in 828 patients. Many of the 172 cut-downs were done in children.

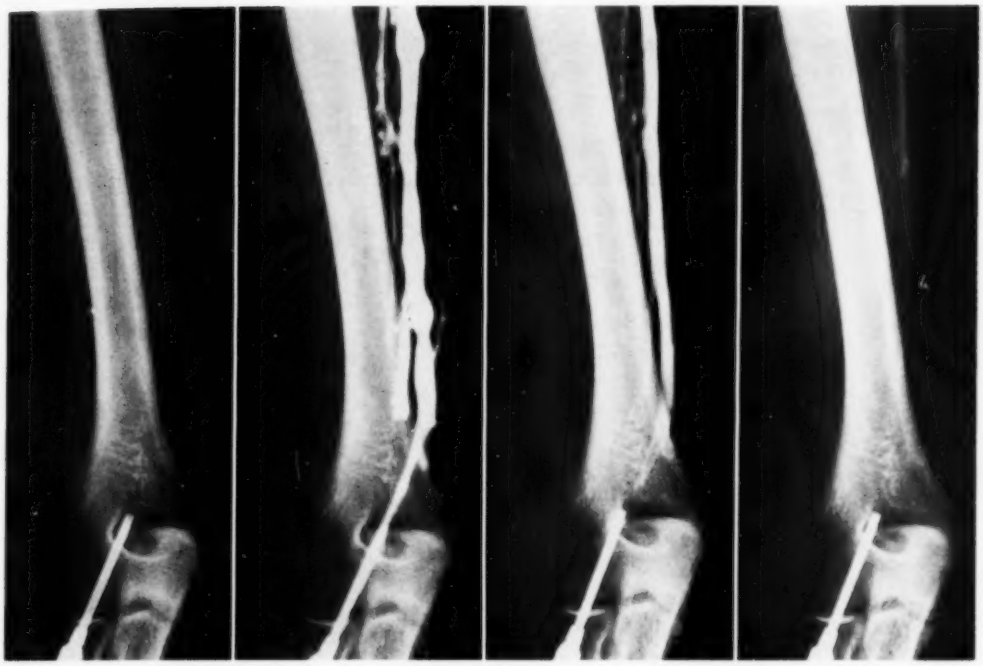

Fig. 3. Angiocardiographic injection, radiographic study. The four films above were made at 0.5 second intervals. In the second film the veins are distended by the forcibly injected radiopaque solution (50 c.c.). The entire injection was about 1 second in duration.

Urokon was given, the incidence of thrombosis was lessened significantly to 48 per cent as compared to 76 per cent following two injections of the same drug. Under comparable circumstances there appears to be little, if any, significant difference in the ability of the three contrast media to produce thrombosis (Neo-Iopax 84 per cent, Diodrast 80 per cent, Urokon 76 per cent, following two injections of each agent). We have never seen an instance in which thrombosis failed to follow three angiocardiographic injections regardless of the contrast material used.

The thrombus which results from angiocardiography is quite firm and may vary in length from a few centimeters to the entire distance from the point of injection to the clavicle (cephalic route) or axilla (brachial route). In none of the 72 patients with thrombi was there edema of the hand or forearm. Tenderness was usually present on palpation of the clotted vein. Pain commonly occurred during the first two or three days but in only 4 or 5 instances did this interfere with the patient's normal daily routine. No evident suppuration occurred although there was questionable evidence of infection in 3 cases. There was nothing to suggest that embolization had taken place.

TABLE III. INCIDENCE OF THROMBOSIS OF INJECTED VEIN ONE WEEK FOLLOWING ANGIOCARDIOGRAPHY. THROMBOSIS OCCURS EIGHT TIMES OUT OF TEN IF TWO INJECTIONS ARE MADE AND HALF THE TIME FOLLOWING A SINGLE INJECTION. THE INCIDENCE OF THROMBOSIS IN COMPARABLE GROUPS OF PATIENTS VARIED SLIGHTLY WITH DIFFERENT DRUGS

Drug and Number of Injections Received	No. of Patients in Group	Per Cent Thrombosis at End of One Week (%)
Diodrast (2 injections)	25	80
Neo-Iopax (2 injections)	25	84
Urokon Sodium (2 injections)	25	76
Urokon Sodium (1 injection)	25	48
All drugs (2 injections)	75	80

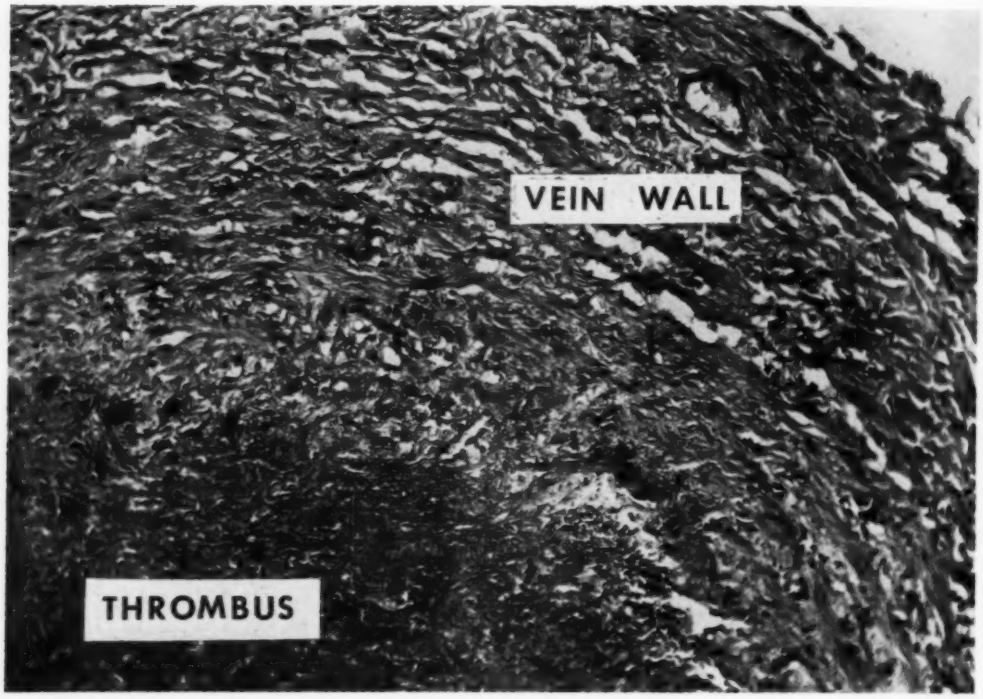

Fig. 4. Thrombosis of injected vein, one week following angiocardiography. Microscopic section of vein biopsy shows a thrombus in the vein lumen. Fibroblasts are invading the thrombus, causing it to adhere to the vein wall. The latter is the site of an inflammatory infiltration.

If severe enough to warrant treatment (here the patient's symptoms are the best guide), the sterile chemical thrombosis which follows angiocardiography is best managed by rest and reassurance. It should occasion no alarm on the part of physician or patient. That the process is inflammatory in origin is indicated by microscopic study of a thrombosed vein. Figure 4 shows the thrombus in a vein from which a biopsy was taken seven days following angiocardiography. The thrombus is undergoing early organization and an inflammatory infiltration is apparent in the vein wall to which the thrombus is firmly attached.

ANGIOCARDIOGRAPHIC MORTALITY

In a total of 1,733 angiocardiographic examinations (2,669 injections) performed at The New York Hospital-Cornell Medical Center and the University of Oregon Medical School, Hospitals and Clinics, there has been no fatality. During these examinations, 540 patients were studied with Diodrast (771 injections), 740 with Neo-Iopax (1,118 injections) and 453 with Urokon (780 injections). This record is not indicative of the actual mortality of the procedure, however. Its risk is amply evidenced by a published report of 23 collected deaths attributable to angiocardiography (10). These deaths occurred during approximately 6,500 examinations. Since that report at least one additional case has been described (12). Not included (since no angiographic examination was performed) were 2 fatalities reported by Morgan (11) where death immediately followed 1 c.c. test doses of Diodrast. Although all of the 24 reported angiocardiographic deaths followed the use of Diodrast (or an otherwise named but chemically similar drug), it is to be emphasized that many more studies have been performed employing this substance than

Neo-Iopax or Urokon. A sufficient experience with both of the latter substances has nevertheless accumulated to allow the observation that they are suitable for clinical application. Of the 24 deaths following angiocardiography, 20 occurred in children of fourteen years of age or younger and 17 in children of five years or younger. All but 4 of the patients had cyanotic congenital heart disease. Young children with cyanotic heart disease therefore represent "maximum risk" for angiocardiography. In this group, death must be considered a calculated risk regardless of the contrast substance employed since such patients tolerate any procedure poorly. Here the decision to perform contrast visualization studies must be made with the greatest care. Where the results of angiocardiography cannot be expected to play a role in the management of the patient, the procedure is to be avoided. Its principal use in the child with congenital heart disease is to demonstrate to the surgeon the abnormal anatomy present. If in the young child collateral methods of investigation serve to rule out surgery as a possible therapeutic approach to a given case, angiocardiography should probably not be done. These remarks do not apply to the adult patient where the risk of the procedure is no greater than that of bronchoscopy.

In 19 of the 24 reported fatalities following angiocardiography (10) sensitivity testing was done and in each instance was negative. In 2 other patients (11) death immediately followed intravenous sensitivity testing with 1 c.c. Diodrast. We therefore are of the opinion that the value of sensitivity testing prior to angiocardiography is largely limited to its potential medicolegal significance.

DISCUSSION

From the patient's point of view, angiocardiography is an unpleasant experience. Fortunately, the subjective reaction is usually of brief duration. In the adult with mediastinal or pulmonary disease angiocardiography may obviate the need for thoracotomy. This is particularly true in certain cases of pulmonary carcinoma where contrast visualization is able to demonstrate overwhelming evidence of inoperability. How false the "conservatism" of the physician who spares his patient the discomfort of angiocardiography, but refers him for predictably fruitless thoracotomy!

A comparative study of the side effects following angiocardiography with Diodrast, Neo-Iopax, and Urokon allows certain generalizations. The immediate reaction to Diodrast is featured by an intense sensation of heat and weakness. The reaction to Neo-Iopax is, in addition, frequently marked by a severe throbbing headache, coughing, and a sense of thirst. Based upon this study and other observations (8, 13, 14) it is the opinion of the authors that the subjective reaction to Urokon is the mildest (least unpleasant) of the three. Although the iodine content of the three substances is not identical (Diodrast 34.9 per cent, Neo-Iopax 38.6 per cent, and Urokon 46.1 per cent iodine in the solutions employed for angiocardiography), we have been unable to observe marked differences in the radiopacity produced during angiocardiography. If angiocardiography in the child with congenital heart disease is excluded, all three agents appear to be reasonably safe. Since the subjective reaction with Urokon appears to be definitely milder than that encountered with either Diodrast or Neo-Iopax and since it appears to be at least comparably safe, the authors are of the belief that Urokon is probably the best available contrast substance for angiocardiography.

Thrombosis of the vein injected for angiocardiography is probably best regarded as a "necessary evil." The patient who receives but one injection has a fifty-fifty chance of escaping this minor sequela while the odds in favor of thrombosis are four to one in those receiving two injections. The patient should be so advised and reassured that symptoms will be both mild and temporary.

It is obvious from this report that the ideal contrast substance for angiocardiography has not yet been developed.

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SUMARIO

Substancias de Contraste para la Angiocardiografía: Estudio de los Efectos Subsidiarios

Este estudio proponíase determinar la naturaleza de la reacción inmediata observada en los enfermos sometidos a la angiocardiografía. Para ello, poco después de cada inyección de una substancia de contraste, interrogaba a los enfermos adultos que se prestaban a ello un médico que no conocía el medio empleado. El Diodrasto, el Neo-Iopax y el Urokón sódico en soluciones concentradas fueron usados cada uno en 25 exámenes, constando cada examen de dos inyecciones de la acostumbrada dosis de 40 a 50 c.c. de la substancia de contraste a intervalos de unos quince a veinte minutos.

El estudio de los efectos subsidiarios consecutivos a la angiocardiografía permite ciertas generalizaciones. La reacción inmediata al Diodrasto caracterízase por una intensa sensación de calor y debilidad. La reacción al Neo-Iopax se señala, además, frecuentemente por cefalalgia pulsativa grave, tos y sensación de sed. Basándose en este estudio y en observaciones ajebas, opinan los AA. que la reacción subjetiva al Urokón es la más leve (menos desagradable) de las tres. Aunque no es idéntico el contenido de yodo de las tres substancias (Diodrasto 34.9 por ciento, Neo-Iopax 38.6 por ciento y Urokón 46.1 por ciento), no se observó mayor diferencia en la radiopacidad producida durante la angiocardiografía. Si se excluyen la angiocardiografía en niños que tienen cardiopatía congénita, las tres substancias parecen ser bastante inocuas. Como la reacción subjetiva al Urokón parece ser manifiestamente más leve que la notada al Diodrasto o al Neo-Iopax y como aquél parece ser a lo menos igualmente inocuo, creen los AA. que el Urokón es probablemente la mejor substancia de contraste disponible para la angiocardiografía, aunque es evidente que no se ha encontrado todavía el medio ideal.

Cuando aparece trombosis en la vena inyectada para la angiocardiografía, lo más acertado probablemente es considerarla como "mal inevitable." El sujeto que no recibe más de una inyección tiene cincuenta por ciento de probabilidades de evadir esa secuela secundaria, bajando esas probabilidades a veinticinco por ciento en los que reciben dos inyecciónes.

DISCUSSION

Wendell G. Scott, M.D. (St. Louis, Mo.): Doctor Dotter has given us a careful report of his extensive experience in the angiocardiographic examination of patients. It is time that we evaluate the reactions these patients undergo when they are injected intravenously very quickly with a large amount of a concentrated chemical for contrast examinations.

In general, our experience has been similar. Practically every patient has noticed a sense of warmth. They have been flushed and have complained of some arm pain. In the exhibit by Drs. Porporis, Zink, Wilson and associates are summarized their experiences with 2,500 injections of 70 per cent Urokon which was used principally for urographic examinations.[1] The injections were not made as quickly as is required for satisfactory angiocardiographic examinations, but nevertheless the injections were given within a matter of two to four seconds, which is still quite rapid. They report that only 4 cases out of 2,500 showed definite symptoms of syncope. There were no fatalities. Only about 12 per cent experienced undesirable symptoms similar to those listed in Dr. Dotter's chart.

These reactions have been referred to as "Diodrast reactions" and are largely due to the nature of the compound itself. There is, however, considerable evidence to show that the intensity of the reaction can be influenced by the speed of the injection and by the volume of the contrast medium that is injected.

I was a little surprised by Dr. Dotter's statement that half of his patients who receive more than one injection will have complete thrombosis of the vein. I don't question this; I am sure that it must occur. We haven't followed up our patients carefully enough to confirm it. It has been demonstrated this morning that when injections are made within one second there is marked distention of the vein and definite damage to it, otherwise it would not become thrombosed. If the injection is given a bit slower, however, and is not repeated, a thrombosis need not necessarily follow. I say that because in injections requiring two or three seconds, we are quite certain that we haven't had that high percentage of patients with thrombosis.

The important problem is what can we do to make angiocardiographic injections safer and less uncomfortable to the patients and yet provide a satisfactory examination. First, we have to be more careful in our selection of patients. We have to select only those who may profit from an angiographic examination, and for whom something can be done after the diagnosis is established. This means more careful study of patients in the cyanotic group with congenital malformations of the heart. Second, we should try and limit our injections to only one. Dr. Dotter has shown definitely that in twice as many of the patients who had more than one injection thrombosis occurs. Therefore, to obtain a comprehensive examination from one injection, we have to take serialized exposures or employ the technic developed by Dr. Wilson, in which a scintillation counter is placed over a peripheral artery distal to the portion of the vessel to be studied radiographically. As soon as the contrast medium, to which a radioactive chemical has been added, reaches the scintillation counter enough gamma rays are picked up in a fraction of a second to set off the radiographic exposure. In this way the collection of opaque material can be pictured at its maximum concentration in the particular place in the vessel to be investigated. Simultaneous biplane angiographic equipment also makes it possible to obtain a more comprehensive examination as both the anteroposterior and lateral views can be taken simultaneously following a single injection.

A third method for improving angiographic technics is through the development of better contrast media. While Urokon is most satisfactory, I am certain that the pharmaceutical companies are trying to develop a better contrast medium and undoubtedly will do it in time.

Fred Silverman, M.D. (Cincinnati, Ohio): I believe some amplification is necessary concerning Dr. Dotter's statement that the young child with cyanotic congenital heart disease represents the maximum risk patient. Assuming that we are now concerned with that small group of children for whom angiocardiography is indicated, we find that the majority do have cyanotic congenital heart disease. Any type of procedure to which these children are subjected—anesthesia, tonsillectomy, any type of stress, pneumonia, emotional excitement—might well be expected to carry a higher mortality than the same procedures or stresses in any other group of patients. It is, therefore, not entirely valid to compare the angiocardiographic mortality in these children with that of the total population at risk; the comparison is made more properly with non-cyanotic heart disease in children in the same age group. Dr. Dotter's statement is factually true, but I do not believe he would want it used as an argument for withholding the procedure from the group of patients who may have the most to gain from it.

If the comparison were to be made with children with non-cyanotic heart disease, it is probable that the statement would still be true. When cyanosis is due to an intracardiac right to left

[1] See also their paper on page 675 of this issue.

shunt, as in the case of an over-riding aorta, a high concentration of the contrast agent may be brought to the carotid arteries and to the brain. Recognizing that this situation may contribute to the mortality rate in cyanotic children, we believe that the carotid vessels should be occluded by pressure during the procedure. To lessen the strain of excitement and discomfort in those children who otherwise would tolerate the examination under local anesthesia, we have found it helpful prior to the actual injection of medium to give just enough intravenous pentothal to put the child to sleep. This eliminates the subjective complications described by Dr. Dotter, but substitutes the risks of general anesthesia.

As Dr. Scott, we were surprised at the incidence of thrombosis in Dr. Dotter's series. We use cutdowns routinely, and whenever possible inject through a large catheter passed up to the vena cava. The surgical member of our team inspects the wound regularly and removes the sutures at the end of one week. We have no figures, but vascular thromboses have been extremely rare in our experience.

Charles T. Dotter, M.D. (*closing*): After thanking the discussants, I should like to add a comment that I hope you won't accept in the wrong spirit. From this platform at this radiological meeting I have heard the word "dye" misused by 14 different radiologists. We speak of radiopaque agents when we refer to substances such as Diodrast, Neo-Iopax, Urokon, Lipiodol or Iodochlorol. We are *not* speaking of dyes. The use of the term "dye" in reference to a radiopaque agent is almost invariably an expression of ignorance. Tetraiodophenolphthalein for gallbladder visualization represents an outmoded exception. (Dr. Dotter wrote on the blackboard the words: "NEVER SAY DYE!")

Examination of Small Intestine with Carboxymethylcellulose[1]

I. E. KIRSH, M.D.[2], and M. A. SPELLBERG, M.D.[3]

MOST OF US have experienced difficulty at times in deciding whether a small intestine is normal or abnormal by roentgen examination, and further, if abnormal, what name to give to the condition. Different workers use different procedures, administer the barium in different mixtures, and use different terms to describe the resulting radiographic appearances. There is a widespread desire for reliable criteria for the limits of normal and for the best possible examination procedure.

We find that suspensions in water of barium sulfate and the sodium salt of methylcarboxycellulose[4] are stable and inert physiologically, have a rapid small-intestine transit time, and produce a good mucosal pattern in patients without small-intestine disease.

Zimmer (1) made extensive studies of the settling of barium (*in vitro* and *in vivo*) in distilled water, in hard tap water, in artificial gastric juice, and in artificial intestinal juice. He found that pure barium produces a coarsened mucous membrane pattern and segmentation. He says that when "protective colloids" are added a "gracefully barbed" mucosa shows up. The preparation he recommends activates peristalsis so that the entire small intestine can be visualized in an hour.

Frazer, French, and Thompson (2) showed how the "segmentation pattern" could be induced in normal subjects. They gave, at different times, a long list of substances with barium by mouth and by duodenal tube. The following produced segmentation: hypertonic saline, sodium bicarbonate, and glucose; also sodium oleate, hydrolyzed olive oil, sprue fecal fat, and olive oil. They also found that an abnormal small bowel pattern was induced in a healthy individual by the ingestion of a fatty meal the evening before the examination. Experiments *in vitro* showed that when mucus was added, fluocculation resulted. There was the same picture when barium mixed with mucus was placed in a loop of intestine removed from a cadaver. Frazer and his associates believed that the segmentation pattern they induced in normal people was indistinguishable from the "deficiency pattern." It would seem that altered neuromuscular activity, as suggested by Golden, is not the correct explanation for this phenomenon for it could not account for the changes observed in the normal small bowel examined post-mortem.

That the segmentation pattern is associated most often with defective fat absorption was shown not only by these authors, but also by Snell and Camp (3), Gambill (4), and Kantor (5). The conditions which may produce it are: tropical and non-tropical sprue, celiac disease, obstructive jaundice, pancreatic fibrosis of infants, pancreatogenous diarrhea (Kirklin), mesenteric lymphatic obstruction, and Whipple's disease. Gambill, in a study of patients with pancreatic calcification, found steatorrhea in 32 per cent of those giving a history of pancreatitis. In the cases of "idiopathic steatorrhea" reported by Snell and Camp, x-ray examination revealed a smoothing out of the duodenal contours, blunting of the valvulae conniventes of the jejunum, clumping of barium in elongated masses, and areas of dilatation with delayed motility. These

[1] Published with the approval of the Chief Medical Director, Veterans Administration. The statements and conclusions published by the authors are the result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration. Accepted for publication in August 1952.

[2] Physician in Charge, Diagnostic X-ray Department, Hines VA Hospital, Hines, Ill.

[3] Attending Physician in Gastroenterology, Hines VA Hospital; Clinical Associate Professor of Medicine, University of Illinois, College of Medicine.

[4] Carmethose, trial amounts supplied by Ciba Co.

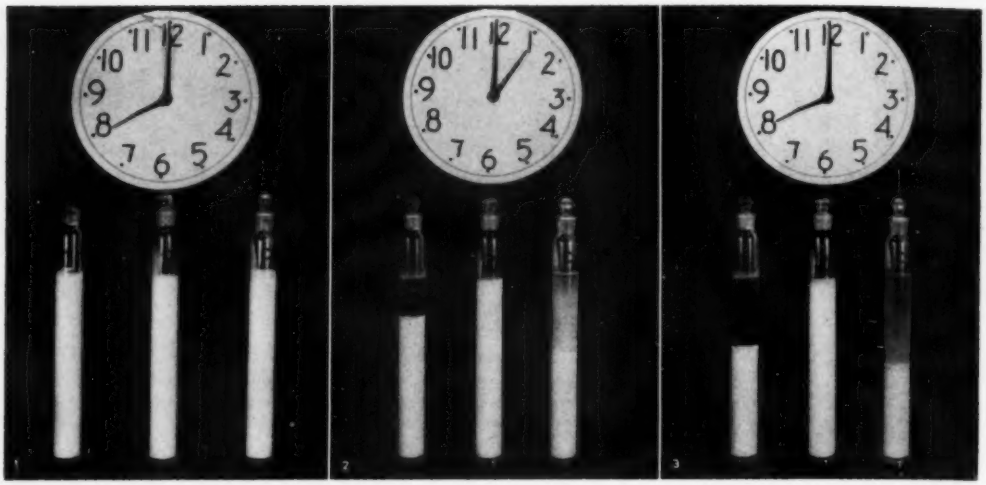

Fig. 1. Initial appearance of barium suspensions: 50 gm. of barium sulfate-SCMC in the tube in the middle; 50 gm. of barium with water on the left; 50 gm. of barium with water and 1 gm. of gastric mucin on the right.
Fig. 2. After five hours, negligible settling of the barium-SCMC.
Fig. 3. After twenty-four hours, still practically no settling of barium-SCMC. Greatest amount of settling in tube to which gastric mucin was added.

authors state that the radiographic changes regressed with clinical improvement. Kantor (5), in describing the roentgen appearance of idiopathic steatorrhea, coined a striking term—the "moulage sign." A moulage is a model obtained by pouring wax into a mold and allowing it to harden. That is what this author was reminded of when he viewed roentgenograms in which there was ironing out of the valvulae conniventes in the duodenum and jejunum.

Pendergrass and his co-workers (6) found that the addition of fat (olive oil) to barium produced the same appearance. They warn that "the pattern and motility obtained in normal individuals with a variation of the vehicle of the barium meal may suggest serious pathological lesions." Ettinger (7) in discussing the deficiency syndrome says that one cannot correlate specific patterns with specific deficiencies. Ross Golden (8) states that he no longer uses the term "deficiency pattern"; he prefers "disordered motor function" but admits that this expression is still not specific.

Barium-water suspensions have proved so unsatisfactory in studies of the small bowel that various substances and procedures have been tried in an effort to obtain better visualization of that region. Adolph and Taplin (9) found that micropulverized barium sulfate in water is precipitated on the mucous membrane, resulting in better demonstration of the small-intestinal pattern in normal patients. Gastric mucin was added to the barium suspension by Alexander (10), who claimed this mixture had a decreased tendency to sedimentation and that it enhanced the small bowel appearance. This is hard to understand in view of the experiences of others, with mucus added to barium (2). It is not supported by our results (Figs. 1, 2, and 3). Other preparations which have been advocated are Zimmer's "Alubar Wander" (1), and the colloidal barium of Jones, Kaplan, and Windholz (11).

Sodium carboxymethylcellulose (hereafter designated SCMC for convenience) has been used by one of us (M.A.S.) in the treatment of peptic ulcer (12). Since it is inert and hydrophilic, it tends to prevent impaction of the barium in the colon. It is viscous in aqueous solution and is inclined to adhere to the mucous membrane of the gastrointestinal tract. Its value in the visualization of esophageal varices

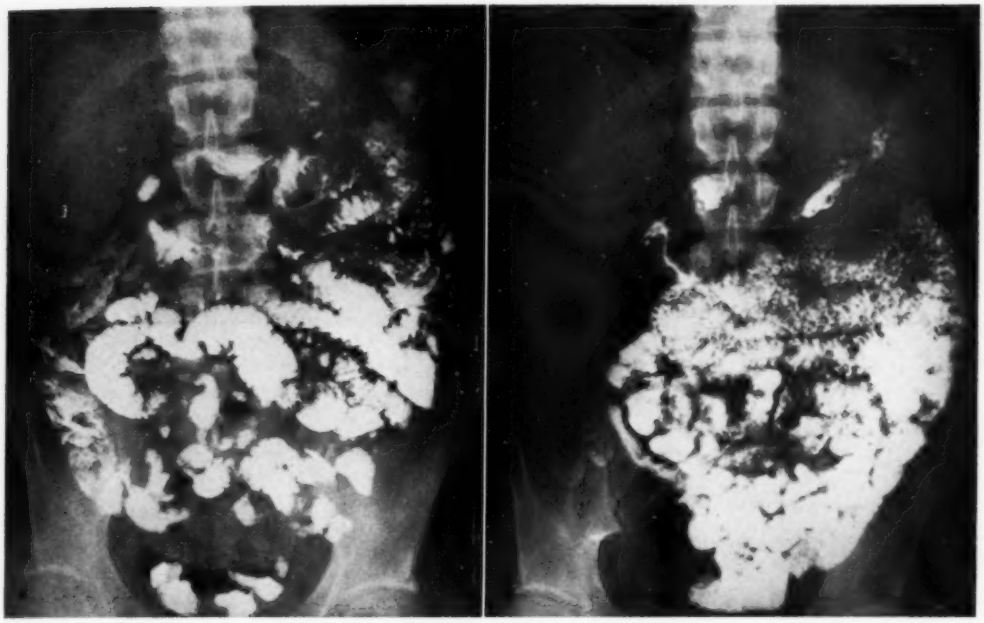

Fig. 4. Apparently abnormal small-bowel pattern, two-hour film, barium sulfate and water.
Fig. 5. Same patient, one-hour film with SCMC-barium. Good mucosal pattern.

will be the subject of a subsequent report. It is also being tried, with promising results, in examination of the colon, especially in air-contrast enemas. In preparing the material for use, we found that the suspension was more stable when we prepared it according to Marks' technic (13), that is, a mixture of SCMC powder and barium sulfate in the proportion of 1:40 by weight (2.5 per cent of SCMC powder in barium) was stirred in water, using four ounces of the dry mixture in eight ounces of water. Figures 1, 2, and 3 show that there is very little settling of the barium-SCMC mixture, even after twenty-four hours. For comparison, observe the settling of plain barium and water (on left) and barium, water, and mucin (on right) in these same figures. Our routine for small-bowel examination calls for posterio-anterior films of the abdomen at fifteen-minute and one-half, one-, one- and-one-half, and two-hour intervals. The two-hour film is examined by the roentgenologist, and further films are made as indicated.

Since we have used the above contrast medium, we feel that we can interpret small-bowel studies with more confidence than when we administered plain barium and water mixtures. We no longer see peculiar small-intestinal patterns in patients without small-intestine disease. As an example, Figure 4, a two-hour film with a barium-water mixture shows flocculation, segmentation, widened loops, and blunted mucous membrane folds. In Figures 5 and 6, which are one-hour and two-hour films of the same patient with barium-SCMC, a delicate mucous membrane pattern is seen throughout, with good continuity of the loops of jejunum and ileum. In other words, by the use of the new medium, we were able to establish that the small intestine was normal, whereas with the conventional barium and water the small intestine appeared abnormal.

Another advantage we found with the use of the SCMC-barium preparation is the rapid transit time regularly seen in the normal small intestine. The small intestine is sometimes visualized in its en-

Fig. 6. Same patient as in Figs. 4 and 5, two-hour film with SCMC-barium. Smal lintestine has normal appearance.

tirety in the one-half hour (Fig. 7) or one-hour film, and in most instances by the time of the two-hour film the small-bowel examination is complete (except in patients with small-intestine disease). Thus, the inconvenience of protracted examination in patients without small-bowel disease is avoided.

In none of our patients has there been any ill-effect which might be attributed to the addition of SCMC to the barium. In fact, we believe our patients are able to evacuate this material more easily than the plain barium sulfate, which is notorious for its tendency to harden while in the colon.

ILLUSTRATIVE CASES

CASE I: *Steatorrhea with pancreatic lithiasis:* R. W., a 59-year-old Negro man with a history of frequent vomiting, pain in the epigastrium, and 18-pound weight loss in three months, followed by dysphagia and regurgitation. Roentgenographic examination (Fig. 8) shows an obstructive lesion in the distal end of the esophagus. In both Figures 8 and 9, the pancreatic calcification is visible, as well as the blunted mucosal folds in the jejunum with sausage-like loops due to steatorrhea. At necropsy a carcinoma of the cardia of the stomach extending into the lower end of the esophagus was found, and the calcifications in the parenchyma of the pancreas were confirmed. Congestion and hyperemia of the jejunum and ileum were also noted.

Fig. 7. Visualization of entire small bowel one-half hour after barium-SCMC.

CASE II: *Pancreatic steatorrhea* O.F. (Reg. 238 733): A white man, aged 58, complaining of diarrhea since 1917. As a rule, he had between five to twelve foul, foamy stools daily. He had lost considerable weight. Our study showed anemia, low serum proteins (albumin 1.5 gm., globulin 3.8 gm.), and generalized edema. On one occasion the amount of fat in the stool was 58.6 gm. in twenty-four hours and on another 41.6 gm. Our final impression was that we were dealing with a sprue due to inadequate absorption from the small intestine, pancreatic deficiency, or both. Notice, in Figure 10, the segmentation and loss of normal mucosal markings in the jejunum. These changes are due to the retained fat in the lumen.

CASE III: *Tuberculous peritonitis:* G. T., a 39-year-old colored man who had been hospitalized five years ago and again three years ago because of a left pleural effusion and who had also received treatment for dementia precox. He had abdominal distention and pain, vomiting, and loss of weight. Examination showed abdominal distention and a mass in the right upper quadrant. Small-bowel

studies revealed slow motility, abnormal mucosa, thickened walls of small intestine and parallel loops (Fig. 11).

CASE IV: *Changes due to scleroderma:* J. C. B., a 55-year-old colored man with scleroderma involving the skin, esophagus, and small intestine. This diagnosis was confirmed a biopsy of the skin. The patient was being treated with ACTH and Cortisone.

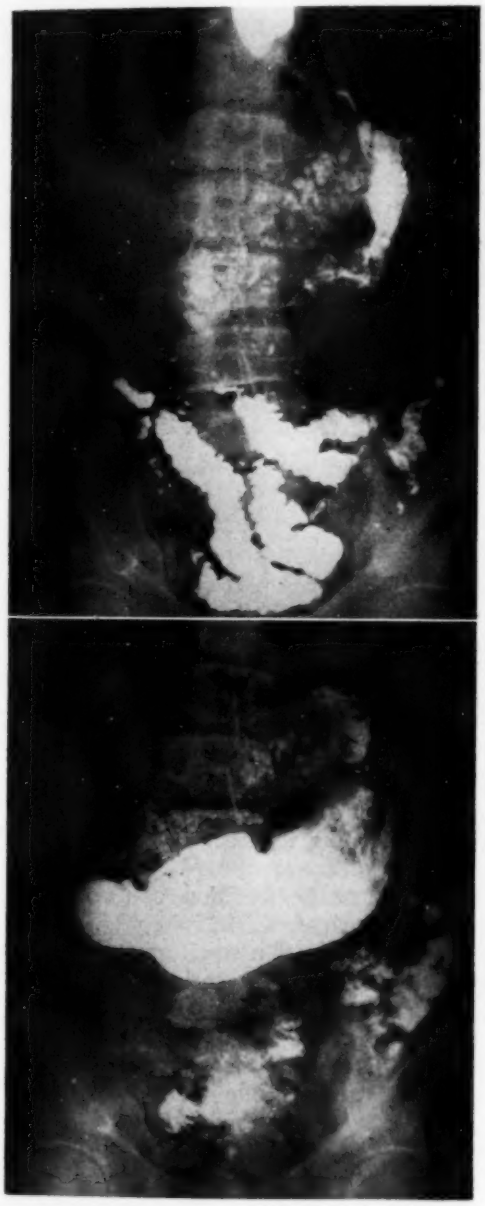

Fig. 8 (*above*). Case I. Steatorrhea in pancreatic lithiasis. Barium-SCMC. Carcinoma of the esophagus is also present.

Fig. 9. (*below*). Case I. Blunted mucosa in jejunum. Barium-SCMC.

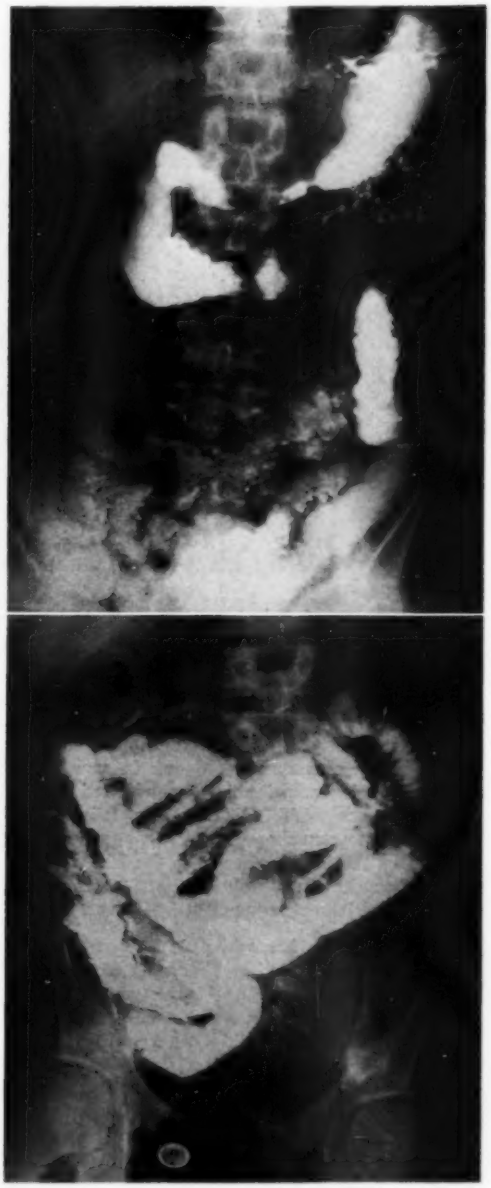

Fig. 10. (*above*). Case II. Pancreatic steatorrhea without pancreatic lithiasis. A fine example of the moulage sign in the duodenum and jejunum. Barium-SCMC.

Fig. 11. (*below*). Case III. Tuberculous peritonitis. Note thickened walls and parallel loops. Barium-SCMC.

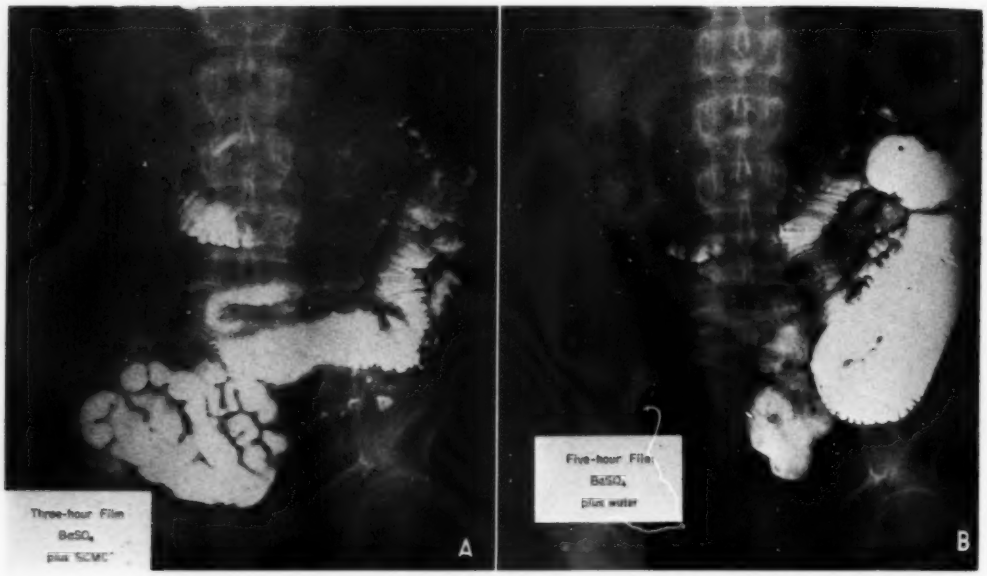

Fig. 12. Case IV. A. SCMC-barium, three-hour film. Changes due to scleroderma. Motility of small intestine is decreased, and there is mucosal irregularity in the distal jejunum. Note the broad segment with the "ironed out" folds. B. Five-hour film with barium-water. The medium had not yet reached the pathological segment of jejunum.

The roentgen appearance of the jejunum (Fig. 12) suggests submucosal infiltration similar to that present in the subcutaneous tissues in such cases. The pathologic condition is demonstrated in the three-hour film with SCMC-barium (Fig. 12A). This roentgenogram shows that the opaque material has reached the ileum, whereas in the film with the plain barium the contrast substance had not reached the abnormal jejunal segment at five hours.

CASE V: *Regional enteritis:* A. L. F., a 60-year-old white male who had had diarrhea with cramps in the right lower quadrant for thirty years. Two years ago, at operation at another hospital, a Meckel's diverticulum with what was described as peri-enteric induration and partial obstruction was removed. Because of persistence of symptoms, he was admitted to Hines VA Hospital. On small-bowel study, an area of marked stenosis was seen to be persistent in a loop of jejunum in the right side of the abdomen, with dilatation of a segment proximal to it (Fig. 13).

CONCLUSIONS

1. The interpretation of roentgenograms of the small intestine following the administration of the usual barium-water suspensions is often difficult, due to their tendency to produce fluocculation, particularly when mucus is present.

2. "Deficiency pattern" or "disordered motor function" of the small bowel is not an uncommon x-ray diagnosis. It may be inaccurate because it is not sufficiently appreciated how often barium-water mixtures produce segmentation and fluocculation, especially in the presence of mucus. It is our belief that the physical state of the barium may evoke the production of mucus, leading to flocculation in patients without intestinal disease. It is for this reason that the addition of "protective colloids" such as SCMC is helpful.

3. Addition of a small amount (2 1/2 per cent) of sodium carboxymethylcellulose adds to the stability of the barium suspensions.

4. This material also shortens the small-intestine transit time and improves the intestinal pattern in normal cases.

5. Four cases are presented briefly to illustrate the small-bowel appearance with this medium in several disease states.

NOTE: Acknowledgment is made to the Medical Illustration Department, Hines VA Hospital, for the photographs.

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Fig. 13. Case V. Regional enteritis. "String sign" and dilated segment in jejunum (four-hour film). SCMC-barium.

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SUMARIO

Examen del Intestino Delgado con Suspensión de Bario-Carboximetilcelulosa

A menudo resulta difícil la interpretación de las radiografías del intestino delgado, después de administrar las habituales suspensiones de bario en agua, debido a la tendencia de éstas a producir floculación, en particular cuando existen mucosidades.

No son raros los diagnósticos roentgenológicos de "patrón de deficiencia" o "trastorno de la función motora." Esto puede ser inexacto por no darse los radiólogos cuenta suficiente de la frecuencia con que las mezclas de bario y agua producen floculación y segmentación, sobre todo cuando hay mucosidades. Opinan los AA. que el estado físico del bario puede ocasionar producción de mucosidades, conduciendo a floculación, en sujetos sin afección intestinal. Por esa razón, resulta útil la adición de "coloides protectivos," tales como la carboximetilcelulosa sódica.

La adición de una pequeña cantidad (2.5 por ciento) de carboximetilcelulosa sódica acrecienta la estabilidad de las suspensiones de bario. Esa substancia acorta además el tiempo del paso por el intestino delgado y mejora el patrón intestinal.

Preséntanse sucintamente 4 casos para demostrar el aspecto roentgenológico del intestino delgado con dicho medio en varios estados morbosos.

"Punch-Card" Sorting for Radiological Reports[1]

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THE DESIRABILITY of a low-cost, labor-saving method for cataloging radiological reports is widely recognized. In the training of residents, in the preparation of scientific papers and in undergraduate teaching such a catalogue is indispensable. The radiologist who wishes to review his experience from time to time feels the need for a roster of that experience in an available form. The radiologist in hospital or private practice is frequently called upon to present staff meetings or prepare papers for local medical groups. A quickly available survey of the type and amount of material at his disposal can simplify his task.

The coding and tabulating system to be described was designed to be suitable for both hospital and private office use. It has the advantages of low initial investment in equipment (less than ten dollars), low cost per patient (about four cents), and requires no trained personnel. The actual expenditure of the radiologist's time is minimal. The time spent by clerical workers may amount to less than the time saved by simplification of department routine.

MATERIALS AND METHODS

The equipment required is a 1/8-inch diameter needle, a notching punch (similar to a conductor's punch), and a supply of marginally perforated cards (Fig. 1).[2] When the Keysort cards are threaded by the needle in any given station, those cards which have been notched at that station fall off the needle and the unnotched cards remain in place. By assigning a meaning to each hole or group of holes, this simple behavior becomes the basis for sorting the cards into categories. Suppose the records of male patients have been notched and those of female patients have been left unnotched. A stack of 200 cards can be sorted into "male" and "female" stacks in about eight seconds by inserting the needle through a single hole. The sorting operation has been accelerated about 2,500 per cent.

In practice, the roentgenologist reports the case in the usual way and at the conclusion of the report dictates code numbers corresponding to the one or more diagnoses he has made. From this point on he has no further connection with the system.

When the report is typed, a punch-card serves as the last carbon copy. All the information required to completely identify the card is now printed directly on it. At suitable intervals the cards are punched directly from this information and filed. Thus, when a group of cases is selected, it is not necessary to consult cross-files for the reports.

The Diagnostic Code: The code employed is essentially a modification of that proposed by Hodges and Lampe. The body is subdivided into "fields" which are major anatomical divisions. As far as possible, similar entities in different fields are assigned the same code number. Nine fields are specified within which are 31 diagnostic possibilities. The card actually allows for 99 subdivisions under each field so a more elaborate code can be used if desired. Alternatively, the "field" bank can be employed as a "100's" bank permitting the use of a code with 999 subgroups—about the limit for a practical code intended to be largely memorized. Naturally, each user of such a code will modify it to suit his particular needs. The Hodges-Lampe code can be recommended as a starting point and as a code

[1] Accepted for publication in June 1952.

[2] Distributed by the Medical Projects Company, 612 Waverly Place, Madison, Wis.

Fig. 1. The radiology card, which measures 8 × 10.5 inches.

to which the system described is well adapted.

Space is provided for recording five diagnoses. The code numbers are typed after or below the radiological diagnoses and consist of a Roman numeral which identifies the "field," and an Arabic numeral which identifies the subgroup in that field. For example:

1. Duodenal ulcer, VIII-24
2. Generalized cardiac enlargement, VI-20
3. Calcified primary complex, left, VII-34

Numbers 1, 2, 4, and 7 require but one punch. Numbers 3, 5, 6, 8, and 9 are recorded by punching two of the printed numbers which total the number desired. Thus, 6 is recorded by punching 4 and 2. No punch indicates a zero in that bank.

Year: Only the last two digits of the year are notched. If it is desired to record the month as well, only the last digit of the year is punched in the units' bank and the month is recorded in the tens' bank, according to the following code:

January	no punch	July	4, 2
February	1	August	4, 2, 1
March	2	September	7
April	1, 2	October	7, 1
May	4	November	7, 2
June	4, 1	December	7, 2, 1

Sorting in the usual way will then bring the cards into order by months.

Age: Ages from one to ninety-nine may be recorded. No notch indicates an infant of less than one year. In this instance one may notch C_2 and record the age in months in the "special code 2" bank by using the code above.

Film or Case Number: It is common practice to assign a number to each new patient entering the department. This may or may not be identical with the hos-

TABLE I: SUGGESTED CODE FOR USE WITH THE CONTROL NUMBERS

c_1	The primary diagnosis is recorded in greater detail in "special code 1."
c_2	The patient is less than 1 year old: age is coded in "special code 2."
c_3	The primary diagnosis is recorded in greater detail in "special code 1" and the secondary diagnosis in greater detail in "special code 2."
c_4	Height is recorded in "special code 1," weight in "special code 2," vital capacity in "fifth diagnosis," cardiac area in "fourth diagnosis," and the primary diagnosis is recorded in greater detail in "third diagnosis."*
c_5	Films show progress (or resolution) of abnormality.
c_6	More than 2 diagnoses are recorded.
c_7	Both examinations opposite the deep punch in the "examination type" columns were done at the same time.

* The example after c_4 is given merely to illustrate the complex meanings which can be assigned to a single hole. The remaining examples are of quite general value and the use of c_7 is mandatory to clarify the meaning of a deep notch in the examination type columns.

pital number, depending on whether the hospital keeps permanent records on outpatients. In either event, this number should be used on all subsequent examinations. The film or case number is recorded on the card for two reasons: (1) If the cards are out of order in the file, they can be automatically placed in correct order by a special sort to be described later; (2) when so sorted, all reports of the same patient will be adjacent.

Special Code 1 and 2: The main function of these banks is to record additional data for which no provision has been made elsewhere. The type of information is indicated by the control hole notched. See below. For example, the Hodges-Lampe code reserves an entire field for "intrathoracic tuberculosis." This field has been eliminated in our own modification and intrathoracic tuberculosis, regardless of manifestation, is recorded by notching field VII-13. The precise manifestations of the disease can then be recorded by reference to an auxiliary code, punching special code 1 and 2 and successively diagnosis 5, diagnosis 4, diagnosis 3, etc. C_4 is also notched to positively indicate that this has been done. It will be noted that when the higher diagnosis banks are used for special coding, this will always be apparent from the fact that no field designation is notched. Since, in sorting, one always sorts for field first, these cards will always be discarded when sorting for regular code designations.

Other examples of special codes could be given: VI-23c_1—congenital heart disease coded as to type in special code 1; IV-3c_1—fracture of upper extremity recorded in greater detail according to "standard terminology"; VIII-21PPc_4—pathological proof of primary diagnosis (gastric neoplasm) with pathological diagnosis coded according to "standard terminology."

The use of the special code banks allows for all the refinement in coding which may be desired for special purposes. It is not necessary to punch the special code holes at the time the original coding is done. This saves considerable detail work which may never be necessary. For example, suppose that in a ten-year period, 100 primary tumors of bone have been collected and it is desired to analyze these according to radiological appearance. One might then prepare a code for the special code banks 1 and 2 as follows:

	Unpunched	Shallow Punch	Deep Punch
1.	destructive	productive	diphasic
2.	medullary	cortical	periosteal
4–7.	diaphysis	metaphysis	epiphysis
1.	soft tissue tumor	no soft tissue tumor	
2.	solitary	multiple	single lry č metastases
4–7.	expanding	not expanding	

Other characteristics could be recorded in the 5th diagnosis bank (first, sorting in that bank to determine whether this has been used). The pathological diagnosis could be recorded by a numerical code in the 4th diagnosis bank by assigning numbers to the diagnostic scheme of the Registry of Bone Tumors of the American College of Surgeons.

Control: The control holes need not be used at all. Their use, however, contributes greatly to the flexibility and potential value of the cards. By assigning a code to the control holes, they will function as operators giving directions of unlimited

complexity. Table I is a suggested code for use with the control numbers.

Multiple Diagnosis: In sorting for "antral gastritis" one would first sort in the primary diagnosis bank. This would bring out the majority of such records. Other cases, however, may be in the file with this finding recorded as a secondary diagnosis. It is then necessary to sort in the 2nd, 3rd, 4th, and 5th diagnosis banks to secure all such cases. The number of cards handled can be sharply reduced by making use of the hole labeled "multiple diagnosis." A single sort in this station will eliminate all cards with only a single diagnosis if this hole has been routinely punched.

Department: Up to ten departments may be identified by punching in the usual way. Twelve departments may be distinguished by using the code given under "year." This bank could also be used in departments served by several radiologists to identify the one who interpreted the film.

Referring Physician: By assigning numbers to physicians using a department, it will be possible at any time to make available to each individual the records of his own material. This feature may well be a basis for co-operative studies between radiologists and clinicians in private practice.

P.P. (Pathological Proof): The hole indicating pathological proof will ordinarily be notched at a later date. It is notched whether or not the pathological findings confirm the roentgen diagnosis.

Special Interest: The special interest category is one which will be found most useful in practice. Here are placed cases which present spectacular findings, depict common pathology in an unusually clear and forceful manner, or show the signs of unusual diseases. Films of teaching value, "show cases" and, in short, cases of more than statistical interest are coded "special interest." By sorting in this single station, the radiologist will have immediately before him the cream of his experience.

Unsatisfactory: By selecting the unsatisfactory examinations and then sorting them by type, one can quickly determine where emphasis should be placed in the training of technicians. A check from month to month will reveal whether the number of unsatisfactory examinations is at a reasonably low level.

Examination Type: The arrangement of the examination types was so chosen that it would be seldom that both examinations opposite a pair of holes were made at the same visit. Even if this should occur, notching C_7 assures the recording of this fact. Ten additional holes are provided which can be made to represent examination types not printed on the card. Shallow and deep notches indicate examinations in the left and right hand columns, respectively.

Direct Code Sorting: Both direct and numerical codes are used in the radiology card. Direct coding involves assigning a specific meaning to each hole. It has the merit of eliminating the need for a code book, but this is offset by a definite limitation on the number of entities which can be coded. The patient's sex, "special interest," "pathological proof," "unsatisfactory examination," and "examination type," are examples of direct codes. Sorting by direct code has been illustrated for the sex classification. Special interest cases, unsatisfactory examinations and pathologically proved cases are selected in an identical fashion.

In sorting for examinations in the inner column, the needle is simply inserted in the corresponding inner hole. The desired cards will fall off the needle. However, when attempting to secure the cards of patients who have an examination listed in the outer column, it will be noted that cards with deep, as well as shallow notches, will drop off the needle. The latter can then be eliminated by sorting again with the needle in the deep hole and discarding the cards which drop.

Example: Select cards of patients having an examination of the shoulder.

1. Insert needle in hole 13. "Shoulder" and "stomach" cards will drop. Discard cards still on needle.

2. Insert needle in hole 14. "Stomach" cards will drop; "shoulder" cards remain on the needle.

Numerical Code Sorting: Numerical codes are used when actual numbers (film number, age, date) or when code numbers (special code, diagnostic code) are to be recorded. The punching and sorting procedures are the same in either event.

To select all cards with the same code number, the operator first sorts in the hole, or combination of holes adding up to the given number, and saves the cards which drop. He then eliminates other cards by successively sorting in holes which should *not* be punched for that number and *discards* the cards which fall. In the case of number 6, the sorting needle is inserted in hole 4 and the cards which drop are saved. These are resorted by inserting the needle in hole 2 and only those cards which drop the second time are saved. These will consist of cards numbered 6 and 9. The 9's are eliminated by sorting in hole 7 and discarding the cards which drop. The appropriate holes for sorting a given number are quite obvious with a few minutes of experience with cards and needle.

Example: Select "duodenal ulcer" cards—Field VIII-24. First, sort for 8 in the "field bank," next for 2 in the "tens' bank," and finally for 4 in the "units' bank." It will be noted that as one proceeds from the "field bank" to the "tens' bank," the number of cards to be handled is reduced approximately 90 per cent. A further reduction has occurred by the time the units' column is sorted.

In the example given above, the procedure would have been simplified and a large number of unwanted cards eliminated by a preliminary sort for "stomach" in the examination type column.

To obtain records in which duodenal ulcer is recorded as a secondary, tertiary, etc., finding, the same procedure is used successively in the secondary, tertiary, etc., diagnosis sections. Before proceeding to the secondary sort, a single sort in the "multiple diagnosis bank" will eliminate the number of cards with only a single diagnosis. Naturally, the cards which have been selected by the first sort in the "primary diagnosis" bank are not included in the secondary sorts. Relatively few cards will remain to be sorted after the secondary sort, if cards having a zero (no punch) in the "field bank" are discarded.

In general, it is advisable to sort for the least common characteristic first and perform sorts for directly coded items, before sorting for those numerically coded, as this will most rapidly reduce the number of cards to be handled.

These and other "tricks" of sorting will become apparent with experience in the use of the cards.

Sequence Sorting: To sort a single handful of cards into numerical order, it is only necessary to sort from right to left (1, 2, 4, 7), each time placing the cards that drop behind those that stay on the needle. A *breakdown* sort results in the same arrangement in numerical order, but the entire file of cards can be so sorted. This involves sorting the entire file starting with the 7 hole and proceeding toward the right (4, 2, 1), each time keeping the cards which drop in separate piles. By progressive sorting, the resulting piles will become smaller until they can be easily handled. The piles are then sequence sorted and, when this has been done, the entire file will be in numerical order in the given category. This type of sort will be useful in getting the cards back into order after sorting or, for example, in arranging the entire file to correspond with the diagnostic code for statistical purposes.

Selective Sorting: The outstanding merit of the "Keysort" cards is their suitability for selective sorting. Cards displaying any combination of features may be rapidly secured. If it were desired to obtain a number of films of pelves of eleven-year-old girls to compare with a film which presented some problem in interpretation, these could be obtained by sorting in turn for "pelvis," "female" and "age eleven"

and several thousand cards could be so winnowed in half an hour. Tedious inspection of an equal number of reports might require several days and the result would not be available when wanted.

If two variables are coded in increments on the cards, selective sorting will give directly numbers for insertion in a correlation table. This method of sorting is also directly available for chi-square tests.

Miscellaneous Uses of Mechanical Sorting: No mention has been made of the administrative uses to which the cards may be put. Their original use, and, at present, most common function, is in tabulating information for the use of business organizations, cost accounting, sales analyses and the like. It is believed that as information is acquired, especially with regard to frequency of examination types and their combinations, a contribution can be made toward the design of radiological departments and concrete information obtained to guide the selection of type and amount of equipment.

The card described can be used for therapy records to a certain extent. However, a special card for this purpose is in the preliminary stages of design and will be described later.

SUMMARY

A marginally punched card (Keysort) designed to make the benefits of mechanical sorting of records available to the radiologist is described. Cards may be rapidly sorted by diagnosis, age, sex, type of examination, department, referring physician, and date. A simple procedure will bring the cards into numerical or chronological order. Cases of exceptional interest may be located by a single sorting procedure. Correlation and chi-square tables may be prepared directly. Special codes permit almost unlimited refinement of diagnostic subgroups and are also suitable for acquiring special data for current projects, cost accounting and the like.

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SUMARIO

Sorteo de los Informes Radiológicos en "Fichas Perforadas"

Descríbese una ficha (Keysort) perforada en los bordes, que capacita al radiólogo para obtener el beneficio derivado del sorteo mecánico de sus protocolos. Las fichas pueden así ser sorteadas rápidamente de acuerdo con el diagnóstico, la edad, el sexo, la forma, la clase de examen, el departamento, el médico de cabecera y la fecha. Un procedimiento sencillo colocará las fichas en orden numérico o cronológico. Con un solo sorteo puede darse con los casos de interés excepcional. Pueden prepararse directamente tablas de correlación y de χ^2. Claves especiales permiten una depuración casi ilimitada de los subgrupos de diagnóstico, prestándose también para la adquisición de datos destinados a proyectos corrientes y cálculos de gastos.

Roentgen Visualization of the Rokitansky-Aschoff Sinuses as an Additional Sign of Chronic Gallbladder Disease

A Case Report[1]

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THE RADIOLOGICAL visualization of the Rokitansky-Aschoff sinuses is considered by many as of only academic interest. The case to be reported here, however, illustrates the clinical accuracy of their demonstration as evidence of chronic gallbladder disease.

In the normal healthy gallbladder one rarely sees what are considered to be the Rokitansky-Aschoff sinuses. This term can be applied only to the deep outpouchings of mucosa extending into or through the muscular coat and into the perimuscular layers, leading to separation of the interstices and delicate walls of the muscle bundles. Normally the gallbladder muscle bundles are resistant to such outpouchings. In the presence of inflammation, however, these contractile structures become weakened. With obstruction and chronic over-distention, the mucosa can readily herniate through the intermuscular septa and extend into the perimuscular tissues, even reaching the serosa.

Pathologically the gallbladder in which Rokitansky sinuses are found is usually thickened as a result of chronic inflammatory changes, with the usual inflammatory infiltration of the connective tissues and associated proliferation of fibroblasts and edema. These changes are rarely detected on the roentgenogram because of the reduced contractibility of the gallbladder and its inability to concentrate the usual opaque media.

The pathologist has long used the microscopic and gross detection of Rokitansky-Aschoff sinuses as a basis for diagnosis of chronic gallbladder disease, even in the absence of other changes. As early as the seventeenth century pathologists demonstrated gland-like, branched mucosal outpouchings in the gallbladder walls. It was not until 1861, however, that von Rokitansky (10) adequately described these hernia-like outpouchings, not as true glands, but as herniations of the mucosa extending into the deeper layers of the walls and at times containing small concretions. Halpert (6) later differentiated these sinuses from the true Luschka ducts, which are actually accessory bile ducts joining the liver through the cystic bed. Aschoff (3) later showed that the mucosa of the gallbladder lacks a muscularis mucosae and that the underlying tunica muscularis is somewhat thinly spread and of irregular structure. Through this muscular network penetrate the blood vessels. These potential intermuscular spaces are often separated by increased intracystic tension with associated herniation of the mucosa. This latter observation is of interest in that in all cases of roentgenologically demonstrated Rokitansky-Aschoff sinuses reported there has been present an associated stricture of the proximal portion of the gallbladder. Robertson and Ferguson (9) of the Mayo Clinic found some herniation of the mucosa in 50 per cent of gallbladders of persons over the age of thirty.

The first radiological reference to the Rokitansky-Aschoff sinuses was made in this country by McCorkle and Fong (8), in association with a case of acute pneumocholecystitis. Ackerman (1) and March (7) in 1948 and Bean and Culver (4) in 1950 were the first to bring this condition forth as an entity in the American radiological literature. The pattern of these cases is identical. The gallbladder shows moderate concentration of the medium, with numerous round-bottomed, flask-like outpouchings extending from the mucosa into a

[1] From U. S. Army Hospital, Camp Polk, La. Accepted for publication in May 1952.

thickened gallbladder wall. In none of the cases has there been any essential shrinkage after a fatty meal. A stricture is present in the proximal portion of the gallbladder, and the Rokitansky-Aschoff sinuses are found distal to this. March considered this

Fig. 1. Roentgenogram showing concentration of the opaque medium by the gallbladder. There are evident numerous separate collections of medium which surround the lumen. These separate collections represent filled Rokitansky-Aschoff sinuses.

stricture to be congenital in nature, but it is attributed by Bean and Culver to macroscopic sinuses containing pigment. If the stricture is considered as the cause of the obstruction and over-distention, the frequent finding of Rokitansky-Aschoff sinuses at the pathology table cannot be explained. In the cases described, however, there is present an exaggeration of the pathological condition, which may be logically explained on the basis of a pre-existing stricture.

A 22-year-old Negro male was admitted to the U. S. Army Hospital, Camp Polk, La., July 9, 1951. His chief complaint was right upper quadrant

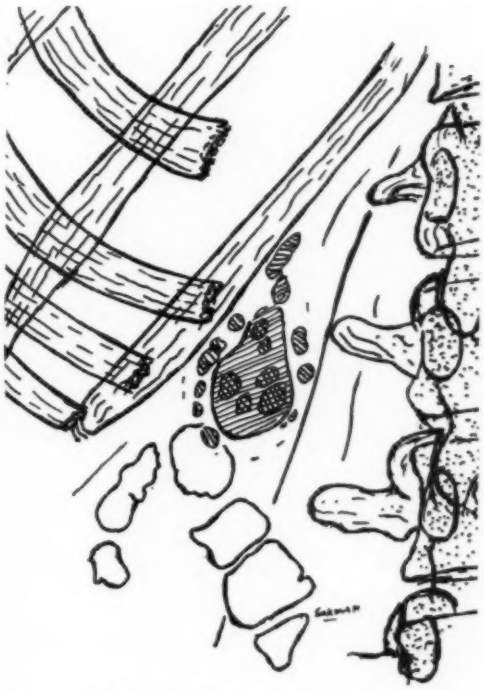

Fig. 2. Drawing to illustrate the findings on the roentgenogram reproduced in Fig. 1.

abdominal pain and belching of two years duration. At the onset, the attacks of pain occurred at intervals of two or three days and lasted only a few minutes. After three or four episodes of this type, the patient was symptom free until February 1951, when the burning pain and eructations recurred. Sedatives, antispasmodics, and antacids produced only partial relief.

At the time of admission to the hospital, the patient was having attacks of right subcostal pain lasting thirty to sixty minutes about ninety minutes following meals, especially after eating greasy food (fried eggs with bacon, specifically). He felt most comfortable on an empty stomach. Bowel movements were of normal color, consistency, and regularity. There was no history of acholic stools or jaundice. The weight had fluctuated since the patient's induction into the Army, and was now 11 pounds below his average civilian weight of 158 pounds. The past history and family history were non-contributory.

On admission the temperature was 98° F.; pulse, 80 per minute; respirations 16 per minute; blood pressure, 110/70. The patient was well developed but somewhat thin. He did not appear to be acutely or chronically ill. The abdomen was soft and was not distended. No organ or mass was palpable. The rectal examination and remainder of the physical examination were entirely negative.

Fig. 3. Changes after a fatty meal, similar to those in Fig. 1.

The *laboratory findings*, July 9, were as follows:

Serum bilirubin
- Direct test.....No reaction
- Indirect test.....0.25 mg. per cent

Prothrombin time..90 per cent of normal

Cephalin flocculation
- 24 hours.....Negative
- 48 hours.....1 +

Urinalysis (July 10). Essentially normal

Blood count
- Hemoglobin.....17.8 gm./100 c.c.
- White cells.....6,000
  - Band cells 4 per cent
  - Neutrophils 58 per cent
  - Lymphocytes 35 per cent
  - Eosinophils 3 per cent

Roentgen Findings: Examination of the upper gastrointestinal tract on two occasions revealed no ulceration or new growth in the esophagus, stomach, or duodenum. The routine preliminary film showed no calculi.

Examination of the gallbladder following ingestion of twelve Priodax tablets revealed good concentration of the medium. There was present, however, a constant defect in the mid-portion of the gallbladder due to spasm or stricture of unknown etiology. The Priodax localized in the glands of the edematous mucosa, *i.e.*, the sinuses of Rokitansky-Aschoff.

Clinical Course: On July 17, 1951, under endotracheal anesthesia with nitrous oxide and ether, a thick-walled gallbladder without stones was removed. The extrahepatic biliary ducts were normal to inspection and palpation. No other abnormality was found within the peritoneal cavity. The postoperative course was uncomplicated. On the tenth postoperative day, the patient was placed on a four week convalescent furlough. At the end of this he was asymptomatic and returned to duty.

Fig. 4. Stricture involving the proximal and mid third of the gallbladder; filled Rokitansky-Aschoff sinuses distal to the stricture.

Pathology: According to the report on the operative specimen by the pathology laboratory, Brooke Army Hospital, Fort Sam Houston, Texas, the wall of the gallbladder was very thick, measuring 18 mm. in one place near the ampulla. It appeared rather firm and greenish in color. No stones were present.

Microscopic examination showed the mucosal epithelium to be composed of characteristic, tall columnar cells with basilar palisaded nuclei. Numerous frond-like projections were seen extending into the lumen of the bladder. These were for the most part defective in respect to mucosal epithelial cells. The underlying lamina propria and perimuscular adventitial tissue showed fibrosis and diffuse infiltration by numerous lymphocytes and eosinophils. The muscularis was somewhat thicker than usual but composed of the characteristic bundles of smooth muscles. Several large Rokitansky-Aschoff sinuses

were seen extending through the muscularis. These were in part lined by columnar epithelial mucosal cells. One such outpouching was filled with amorphous, bright yellow material.

SUMMARY AND CONCLUSIONS

The anatomy of the gallbladder and the pathology of chronic cholecystitis are reviewed. It is pointed out that chronic increased intracytic pressure leads to herniation of the mucosa through the muscularis, producing Rokitansky-Aschoff sinuses. While these features are commonly observed microscopically, their recognition on gross examination and particularly their radiologic recognition are unusual.

A case is presented in which the diagnosis of chronic cholecystitis was made from the radiologic demonstration of enlarged Rokitansky-Aschoff sinuses. The gallbladder was thick-walled with a greatly thickened and narrowed ampullary portion. Presumably, the latter was the basis for the sequence of events resulting in the pathological findings. It is the belief of the authors that visualization of Rokitansky-Aschoff sinuses is an accurate clinical sign of chronic cholecystitis which may be of value in diagnosis of the disease.

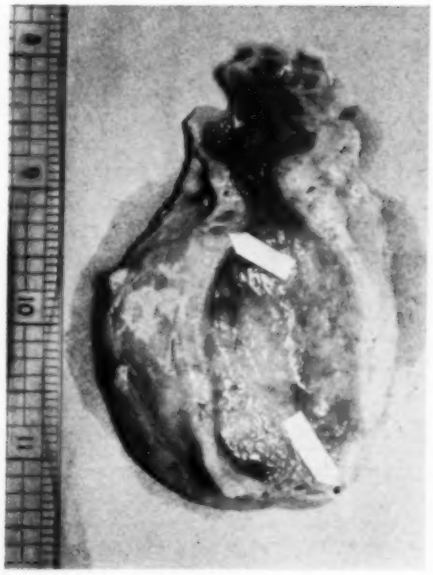

Fig. 5. Postoperative specimen showing the thickened gallbladder wall. The arrows point to the ostia leading into the Rokitansky-Aschoff sinuses. The stricture is evident above the upper arrow.

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SUMARIO

Visualización Roentgenológica de los Senos de Rokitansky-Aschoff como Nuevo Signo de Colecistopatía Crónica: Historia Clínica

Los senos de Rokitansky-Aschoff son bolsitas profundas de mucosa que se extienden hasta la capa muscular de la vesícula biliar o a través de ella hasta las capas perimusculares. Normalmente, los fascículos musculares de la vesícula ofrecen resistencia a esas bolsas, pero cuando existe inflamación, se debilitan esos tejidos contráctiles. Cuando hay oclusión e hiperdistensión crónica, la mucosa puede formar fácilmente una hernia a través de los tabiques intermusculares.

Preséntase un caso se que se hizo el diagnóstico de colecistitis crónica por el descubrimiento de los senos de Rokitansky-Aschoff.

Preoperative Radiographic Diagnosis of Foreign Body Within the Gallbladder[1]

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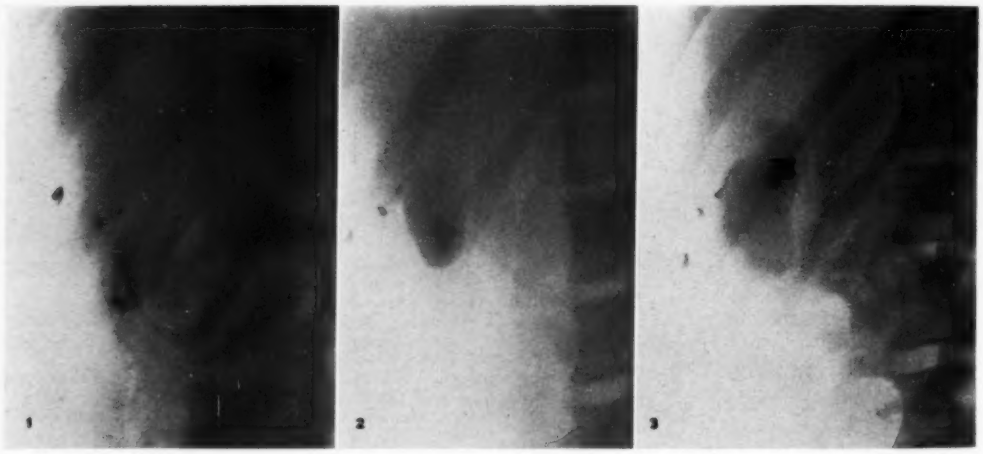
THE ACCOMPANYING radiographs demonstrate an usual case of foreign body within the gallbladder. The case is of interest because of the apparently infrequent occurrence of this type of injury. A search of the literature[3] has failed to disclose a single case.

The patient, an 18-year-old male, had been injured in combat four months previously, at which time he sustained a perforating wound in the abdomen at the right flank, with lacerations of the right lobe of the liver and margin of the gallbladder and a hematoma in the hepatoduodenal ligament. An exploratory laparotomy was done, the liver was repaired, and the hematoma drained. No mention was made of the presence or absence of shell fragments in the region of the involved organs. The postoperative course was uneventful except for a mild persistent "sticking feeling" in the right upper quadrant. This was present throughout convalescence and prevented the patient from standing completely erect. It was believed that the residual symptoms were due to adhesions in the region of operative repair, but that a cholecystogram might perhaps reveal evidence of other disease.

The patient appeared for radiographic study five months after initial injury. All films revealed an irregular shell fragment overlying the shadow of a normally functioning gallbladder. Repeat studies, including fluoroscopy, spot films, and roentgenograms demonstrated a foreign body, 1.5 × 2.5 mm., within the gallbladder. The foreign body was freely movable and changed its relationship with the gallbladder in various positions.



Figs. 1–3. Foreign body in the gallbladder as demonstrated in the upright (Fig. 1), supine (Fig. 2), and Trendelenburg (Fig. 3) positions.

At operation, the gallbladder was exposed and except for multiple adhesions appeared entirely normal. The foreign body could be palpated with difficulty.

[1] From the Department of Radiology, U. S. Army Hospital, Camp Pickett, Va. Accepted for publication in May 1952.

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Because of adhesions, a prophylactic cholecystectomy was done. The patient made an uneventful recovery and the previous "sticking" sensation disappeared.

The gallbladder was found to contain a shell fragment covered with a thin layer of dark material and having irregular, sharp edges. There was a well healed scar at the site of injury, but the mucosal surface was otherwise normal.

SUMMARY

(1) An usual case of shell fragment injury to the gallbladder has been presented.

(2) From this isolated case it may be noted that a foreign body can be present within the gallbladder and produce only mild symptomatology.

(3) No abnormalities of biliary function were observed.

(4) Removal of the foreign body resulted in complete relief of symptoms.

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Fig. 4. Roentgenogram obtained after a fatty meal, demonstrating the shell fragment in the gallbladder. The inset shows the fragment after removal, with a dime for comparison.

SUMARIO

Diagnóstico Radiográfico Preoperatorio de Cuerpo Extraño Dentro de la Vesícula Biliar

Un sujeto de 18 años sufrió una herida penetrante en el abdomen, con laceraciones del hígado y del borde de la vesícula biliar. Después de la reparación operatoria de dichas lesiones, continuó experimentando una persistente sensación "punzante" en el hipocondrio derecho. El examen roentgenológico, a los cinco meses del traumatismo nicial, reveló dentro de la vesícula biliar un cuerpo extraño que medía 1.5 × 2.5 mm. y el cual resultó ser un fragmento de metralla. Se verificó una colecistectomía, reponiéndose el enfermo sin contratiempo.

Gas-Containing Perinephric Abscess[1]

ABRAHAM H. LEVY, M.D., F.A.C.R., and HAROLD N. SCHWINGER, M.D.

Perinephric abscess formation is an uncommon complication of urinary tract disease. This phenomenon is usually secondary to a cortical abscess or infection which has extended to the perirenal areolar tissue. It may also occur as a metastatic lesion, secondary to an inflammatory process elsewhere in the body. Beard (1) states that *Staphylococcus* is the usual offender in the metastatic type, while *E. coli* is commonly found when the abscess is due to a direct extension from the kidney. The finding of gas within such an abscess is unusual, a search of the literature having revealed only one case of perirenal gas collection (6) and one showing generalized gas formation within the kidney and perirenal structures (5). In one of these cases *E. coli* was found to be the causative agent; the other was due to Friedländer's bacillus.

Gillies and Flocks (5) reported a case in a diabetic in which gas was initially demonstrated within the renal parenchyma, arranged radically as if distributed in the interstitial tissues rather than the collecting system. Twenty-four hours later, the gas was distributed throughout the renal and perirenal structures. This patient had a low urinary tract obstruction and *E. coli* was cultured from the blood, urine, and material removed at drainage of the kidney. Kindall (6) reported what appears to be the first case on record of gas within a perirenal abscess. Friedländer's bacillus was the causative agent, with an interesting complication of metastatic pulmonary abscesses appearing after drainage of the perirenal focus. Cultures of material removed bronchoscopically from the pulmonary abscesses also showed the Friedländer bacillus. The etiology of the perirenal abscess was not ascertained, although the possibility of a primary pulmonary infection could not be excluded, as an admission chest roentgenogram showed multiple pulmonary nodules. This patient had a high blood sugar on admission, with a return to normal following recovery. Pyelography after recovery also demonstrated an apparently normal urinary system.

Madison (11) reported a case of a perinephric abscess due to a *B. welchii* infection but without the presence of gas within the abscess. In his series of cases, only one showed *E. coli* on culture; 25 per cent of his patients were diabetics.

CASE REPORT

A 65-year-old, white female was brought to the hospital in a confused state and unable to give an adequate history. She complained of pain in the right abdomen, beginning about three days prior to admission; it was constant and equally severe in the upper and lower quadrants. She had experienced nausea since the onset of the pain and had vomited several times. (She vomited while being questioned; the vomitus was clear yellow, with no evidence of food or blood present.) Her bowel movements were said to be regular, but had been black for the past two days. She thought that she had had fever but no chills. No relevant past history was obtainable.

The patient was poorly developed and appeared to be in some distress. Her abdomen showed a generalized, voluntary muscle spasm. There was tenderness to deep palpation in both the upper and lower quadrants, but no rebound tenderness. Right costovertebral tenderness was elicited. Examination revealed dark feces in the rectum, showing a negative benzidine reaction. The patient was afebrile on admission, but her temperature rose to 104° terminally. The course was rapidly downhill despite adequate fluids, blood transfusions, antibiotics, mixed gas-gangrene antitoxin, and other supportive measures. Death occurred approximately sixty hours after admission.

Laboratory data: On admission, the white blood count was 4,200, with 72 per cent polymorphonuclear leukocytes and 28 per cent lymphocytes. The hemoglobin was 12 gm. Urinalysis showed 3+ glucose but no acetone, 1+ albumin, and many white blood cells in clumps. The erythrocyte sedi-

[1] From the Department of Diagnostic Roentgenology, Kings County Hospital, Brooklyn, N. Y., Dr. Leo A. Harrington, Acting Director. Accepted for publication in May 1952.

mentation rate was 18 mm. in 10 minutes. The day after admission, the blood sugar was reported as 213 mg. per cent, and on the next day as 413 mg. per cent. The blood urea nitrogen was 215 mg. per cent, and the creatinine 3.2 mg. per cent on the day after admission. The white blood count on the day of death was 12,100, with 76 per cent polymorphonuclear leukocytes and 24 per cent lymphocytes, while the sedimentation rate was 24 mm. in 20 minutes.

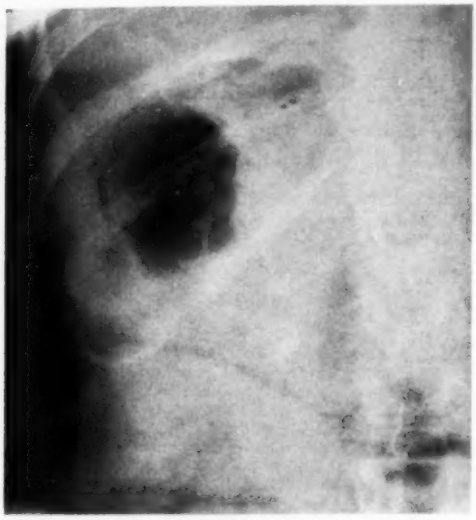

Fig. 1. Circumscribed gas collection in right upper quadrant of abdomen with secondary border of gas about the main collection. This could easily be mistaken for an emphysematous cholecystitis.

At autopsy, the main findings were in the right urinary system and in the right hemithorax. The right kidney was slightly smaller than normal and showed an extensive papillary necrosis, with two small infarcts in the upper pole. There was a large gas-containing abscess at the upper pole of the kidney, extending beyond its capsule to involve the right diaphragm and into the right pleural space, causing an acute diaphragmitis and empyema. There was also a marked dilatation of the right ureter and an acute ureteritis, although no obstructing process could be demonstrated. The urinary bladder showed an acute, hemorrhagic cystitis. Culture of the purulent material removed from the perinephric abscess revealed *E. coli*. Culture of the right kidney substance disclosed *E. coli* and an anaerobic streptococcus.

Comment: The initial roentgenogram of the abdomen showed a suspicious gas collection in the right upper quadrant. In view of the vague history and uncertain physical findings, cone studies of this area were recommended. These were obtained

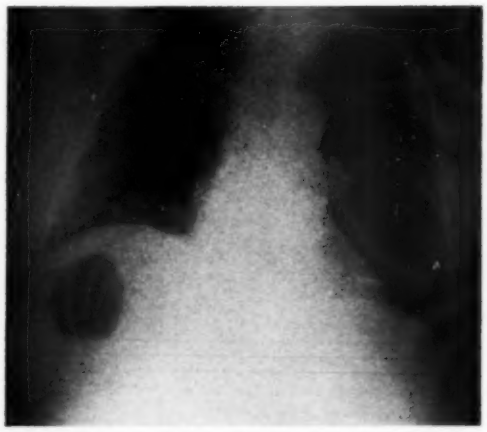

Fig. 2. Initial chest roentgenogram demonstrating well the circumscribed gas collection. Slight elevation of the right dome of the diaphragm is also present.

approximately twelve hours after the initial study and revealed a well circumscribed gas collection within what appeared to be a secondary border of gas, as might occur when a gas infection involved the wall of a viscus (Figs. 1 and 2). Inadvertently, only postero-anterior projections were obtained. These led to an initial impression of an emphysematous cholecystitis, or, of secondary consideration, a liver abscess. Further studies were obtained the following day, showing the collection to be posterior and perirenal in location rather than biliary. At that time, it was also noted that the gas had infiltrated the retroperitoneal space, indicating that the abscess had perforated its capsule (Fig. 3).

Lockwood (10) tabulated the roentgenographic findings to be sought in a case of perinephric abscess. These are: obliteration of the lateral border of the psoas muscle; obliteration of the kidney shadow; curvature of the spine, with the convexity away from the abscess; displacement of the colon; displacement, fixation and limitation of mobility of the diaphragm; renal fixation; anterior and outward displacement of the kidney; rotation of the calyx in the upper pole of the pyelogram. Many authors (2, 7, 8, 9, 12, 13, 14, 15, 16) have described or stressed one or more of these findings. Any one or a combination

Fig. 3. Final examination showing the gas collection to be posterior and perirenal in location. The retroperitoneal extension of the gas is also demonstrated. Residual barium is present in the colon from a previous enema study. Marked sclerosis of the abdominal aorta is noted.

of these changes may or may not be present in an individual case. The finding of gas within the abscess would certainly enhance the diagnostic possibility. Such a finding, however, may cause some confusion with an emphysematous cholecystitis (Fig. 1) unless adequate views are obtained initially. The first studies made in the case reported above could well be (and were) confused with "classic" acute gaseous cholecystitis (3, 4).

The autopsy findings in this case were interesting in several respects. The finding of a necrotizing papillitis, the hydroureter (without obvious explanation) and ureteritis, and the acute hemorrhagic cystitis indicate the mode of production of the final picture. Apparently, an underlying diabetes is a prerequisite in most, if not all, of those cases which lead to a necrotizing papillitis and to gas-forming infections of the urinary tract. It is probable that a triad of diabetes, colon bacillus infection, and low urinary tract obstruction will be found in the great majority of such cases encountered in the future.

SUMMARY

1. A case of gas-containing perinephric abscess is presented, apparently the third such case to be described in the literature.

2. A short discussion of the roentgen signs of perinephric abscess is offered.

3. A possible triad of diabetes, low urinary tract obstruction, and colon bacillus infection is suggested as a common factor in this type of case.

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SUMARIO

Absceso Perinéfrico Timpánico

Preséntase un caso de absceso perinéfrico que contenía gas, aparentemente el tercero de su género que se haya descrito. La radiografía inicial reveló una acumulación sospechosa de gas en el hipocondrio derecho. Los estudios "en cono" de dicha zona doce horas después revelaron una acumulación de gas bien circunscrita dentro de lo que parecía ser un borde secundario de gas, como el que podría haber en una infección gaseosa que afectara la pared de una víscera. Estudios ulteriores demostraron que la aglomeración de gas tenía localización perirrenal.

Como factor común en los casos de este género sugiérese la posible tríada de diabetes, oclusión de la porción inferior del aparato urinario e infección colibacilar.

Experiences with a Rapid Irradiation Technic in Oral Carcinoma[1]

SIDNEY RUBENFELD, M.D.[2]

THE OBJECT OF clinical investigation described here was to determine the possibility of treating head and neck cancer with lethal tumor doses over a short period of time, four to five days. The theoretical possibility of this rapid method was suggested by Strandqvist who established an optimal time/dose range for the treatment of cancer of the skin, in which equal responses were obtained with tumor doses of 2,250 r in one day, 3,400 r in four days, or 4,200 r in six days (Fig. 1).

Although these time/dose relationships were established on skin cancer, their application to tumors arising from the oral mucosa with the same histology appeared feasible. This concept has been expressed by Paterson who feels that lethal tumor doses depend on tumor species. Squamous-cell epitheliomas or adenocarcinomas require a minimal lethal dose not-withstanding the anatomic point of origin.

It was decided to choose various points on the "optimal dosage" curve of Strandqvist, giving relatively large tumor doses over short periods of time ranging from one to five days. "Short time" treatments in head and neck tumors have been tried previously, notably by Coutard (thirteen to sixteen days) and Cutler (nine to twelve days).

DEVELOPMENT OF TECHNICS

The time/dose formulae gathered from the curve of Strandqvist actually formed the basic pattern for treatment of the first group of patients. For instance, the curve indicates that success should be expected if tumors were treated with 2,500 r in one day. The first patient had a carcinoma of the uvula which was irradiated with a dose of 2,000 r, delivered in one day. The immediate response was satisfactory. The next group of patients received tumor doses of 3,000 r in two days. The reactions encountered were strikingly different. The epidermitis failed to heal and, although the tumor may have been destroyed, the resultant mucosal slough unquestionably contributed to the death of 2 patients. This suggested a reduction in dose. Subsequently, 3,500 r in three days was given. The reactions were equally severe, but healed without complications in the majority of patients. Nevertheless, 2 patients sustained mucous membrane reactions which did not heal. These observations prompted a dose of 4,500 r in four days, which resulted in a severe mucositis that progressed to slough. This technic was also abandoned as too intense. Finally, a formula of a tumor dose of 3,500 r in five days was established since this proved to be the safest dose on mucous membranes.

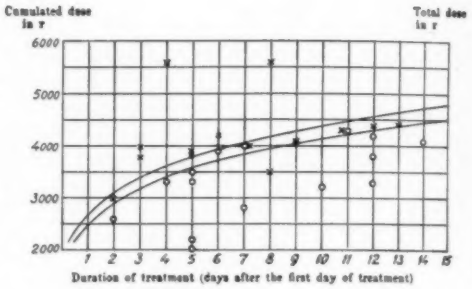
Cumulated dose in r
Total dose in r
6000
5000
4000
3000
2000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Duration of treatment (days after the first day of treatment)

Fig. 1. A reproduction of one of the original curves of Strandqvist, made after a study of cancer of the skin of face and lip. The circles represent recurrence and indicate underdosage. The crosses represent complications and indicate overdosage. Almost all of the crosses are above the oblique line and the circles below the line. The area of optimal dosage is found between the lines. Note especially the time/dose formula of 3,500 r in five days.

Since the initiation of this study in 1948,

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30 tumors of the head and neck have been treated by this so-called "rapid technic." All of the tumors were histologically proved epidermoid carcinoma of various degrees of differentiation. Under the technic described, all cases were treated through multiple skin portals without the use of intra-oral cones.

The radiation quality was a h.v.l. of 1 mm. Cu except in 2 patients whose tumors were treated with a ray quality of 2 mm. Cu h.v.l. Some of the portals were round, 8-cm. diameter; other fields were rectangular, either 6 × 8 cm. or 8 × 10 cm., the latter being the size most commonly employed. The overall time varied from one to five consecutive days. The total tumor dose ranged from 2,000 to 4,500 r. The location of the lesions was as follows:

Tongue	11 cases
Hypopharynx	6
Palate	4
Tonsil	4
Epiglottis	1
Nasopharynx	3
Uvula	1
TOTAL	30

MUCOUS MEMBRANE REACTIONS

The curves representing reactions on the mucosa have been plotted on a master chart as suggested by Friedman. The average reaction curve, mathematically derived, is shown by the heavy black line. Figure 2 shows the reactions in 21 patients whose mucous membrane dose ranged from 3,500 to 4,000 r delivered in two, three, four, or five consecutive days. All but 2 reactions healed without complications (see Fig. 3 for the exceptions). The maximum reaction occurred between the fourteenth and twenty-first day, long after treatment had been completed. Most reactions healed by the thirty-fifth day, although in several patients complete resolution took as long as seven to nine weeks. It is of interest to note that the curve of reaction follows closely the pattern resulting from protracted fractionated radiation given in four to six weeks using standard technics. The epithelitis described by Regaud and Coutard appeared on the thirteenth or fourteenth day and was healed by the twenty-eighth day.

The average epithelitis curve in Figure 2 may be accepted as the pattern of behavior of the mucous membrane when the dose is optimal for safety.

Figure 3 illustrates graphically the behavior of mucous membranes that have

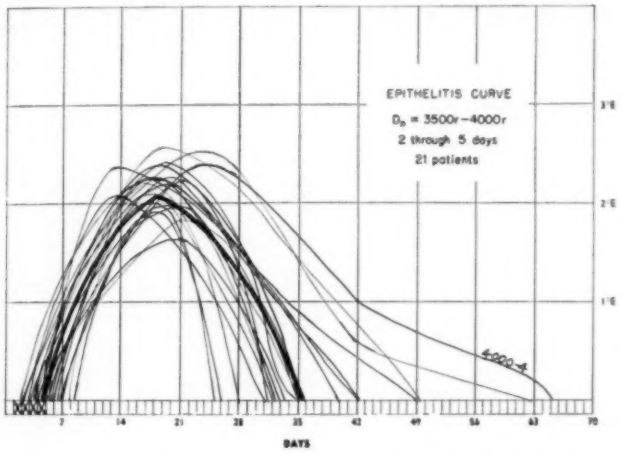

Fig. 2. Epithelitis curves of 21 patients in whom the mucosa received between 3,500 and 4,000 r delivered in two, three, four, or five days. The heavy black line represents the mathematically derived average. Note that visible evidence of reaction appears within the first week and reaches its maximal intensity between the fourteenth and twenty-first day; most membranes heal by the thirty-fifth day. One case of epithelitis required sixty-five days for complete healing.

been irreversibly damaged by excessive doses, such as 3,000 r in two days or 4,500 r in four days. Two patients receiving 3,500 r in three days sustained similar irreversible damage to the mucous membranes.

REACTIONS OF THE SKIN

The problem of adverse reactions of the skin, unlike those of the mucosa, can be minimized by using many ports to divide the total skin dose into tolerable exposures for each area. In the series of patients treated in this survey, two, three, or four portals were used. The size of the fields did not exceed 80 cm.^{2}, because it was felt that with larger ports irreversible reactions would probably be produced. Figure 4

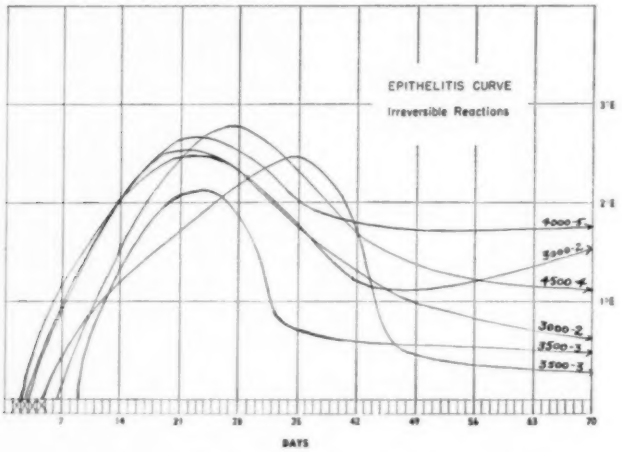

Fig. 3. Epithelitis curves in 6 patients, with irreversible damage to the oral mucosa. The time/dose formula is listed on the extreme right of the individual curve. These effects were observed in an early group of patients treated with a rapid technic.

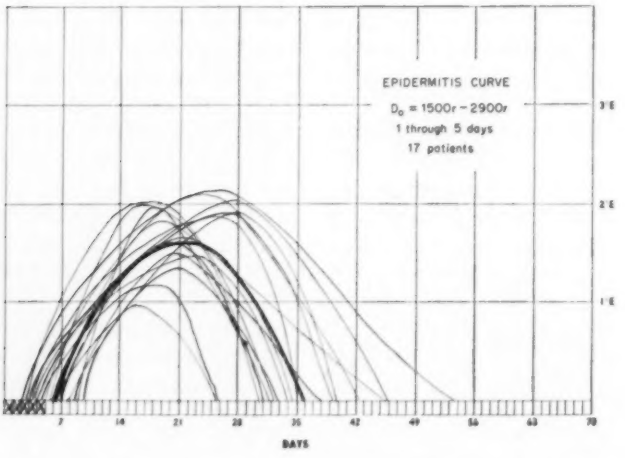

Fig. 4. Epidermitis curves of 17 patients whose tumors were given doses of 1,500 to 2,900 r through skin portals in one through five days. Reactions, although detectable within seven days, reached their maximum intensity by the twenty-first day and healed without sequelae by the thirty-fifth day. All reactions healed. The heavy black line represents the average.

is a scatter chart of reaction curves on skin receiving 1,500 to 2,900 r delivered in one through five days. An average curve was mathematically estimated. All reactions healed without difficulty or sequelae. The usual moist desquamation was reached between the twenty-first and twenty-eighth day, and healing was generally complete by the thirty-fifth day. The height of the reaction appeared later than the maximum reaction of the mucosa. All reactions occurred, as in the mucosa, after the full therapeutic dose had been delivered.

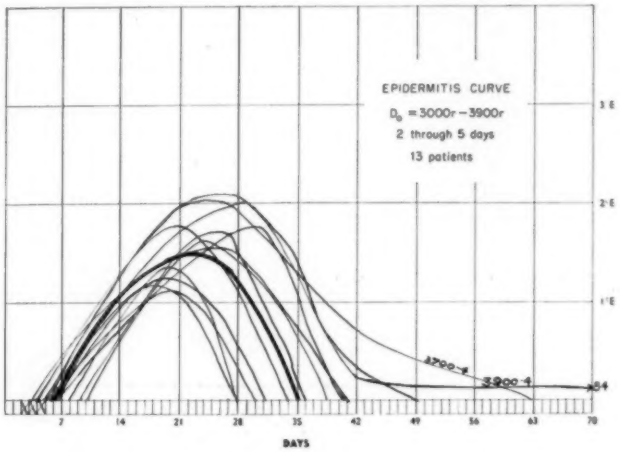

Fig. 5. Epidermitis curves of 13 patients receiving doses ranging from 3,000 to 3,900 through skin portals over a period of two through five days.

Figure 5 is a scatter diagram from a group of 13 patients whose skin portals received doses ranging from 3,000 to 3,900 r delivered over a period of three, four, or five days. Again, all reactions healed, although it took longer for the reactions from the larger doses. For instance, skin receiving 3,900 r in four days healed by the eighty-fourth day, while skin receiving 3,700 r in four days healed by the sixty-third day. On the average, the skin healed by the fifth or sixth week after the first treatment after displaying the usual moist epidermitis.

The trend of these reactions, when compared to conventional protracted fractionated irradiation, indicates an earlier appearance of the epidermitis and a slightly faster healing time. The intensity of the reactions is probably of equal magnitude. No late sequelae were observed up to a period of three years. The skin has remained soft and scarred, but pliable and similar in appearance to skin areas receiving doses incident to protracted fractionated irradiation.

RESULTS AND SURVIVALS

These treatments were initiated early in 1949, so that the results of a three-year-period are available for evaluation. Since advanced and extensive tumors were chosen for treatment in accordance with the above experimental formulae, survival statistics are not expected to be promising. Nevertheless, they are presented for the sake of completeness. Table I shows the

TABLE I: SURVIVAL PERIOD OF PATIENTS ACCORDING TO ANATOMIC LOCATION OF THE LESION.

	Survival			
	1 yr.	1–2 yrs.	2–3 yrs.	3 yrs.
Tongue	D 11			
Hypopharynx	D 5		R	
Palate	D 2	M		
		A		
Tonsil	D	A	A	A
Epiglottis		A		
Nasopharynx		A	R	M
Uvula				R

D Dead. A Alive. R Recurrence. M Alive with recurrence.

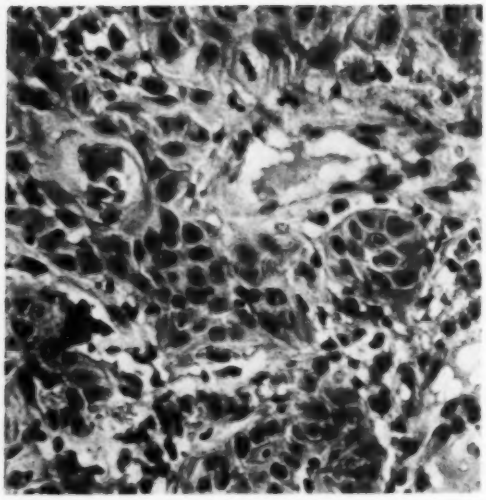

Fig. 6. A. Case I. Epidermoid carcinoma of the tonsil.

4,000 r in five days. After a radical neck dissection subsequent to the arrest of the primary tumor, the patient survived two and one-half years. Tumors of the nasopharynx and epiglottis have responded satisfactorily. Epitheliomas arising from the tonsil yielded most encouraging results; one patient's history is given in detail.

CASE I. *Carcinoma of the Tonsil.* W. C., aged 59, had pernicious anemia for ten years. In 1949 he noticed some pain in the right jaw associated with excessive salivation. Examination on April 22 of that year showed an irregular mass in the right tonsillar fossa. This mass was indurated and fixed and extended on to the posterior pharyngeal wall. No lymph nodes were felt. Biopsy revealed an epidermoid carcinoma (Fig. 6 A).

Using the standard quality x-ray of h.v.l. of 1 mm. Cu, the lesion was treated on April 24, 25, and 26, 1949, through right and left mandibular and one

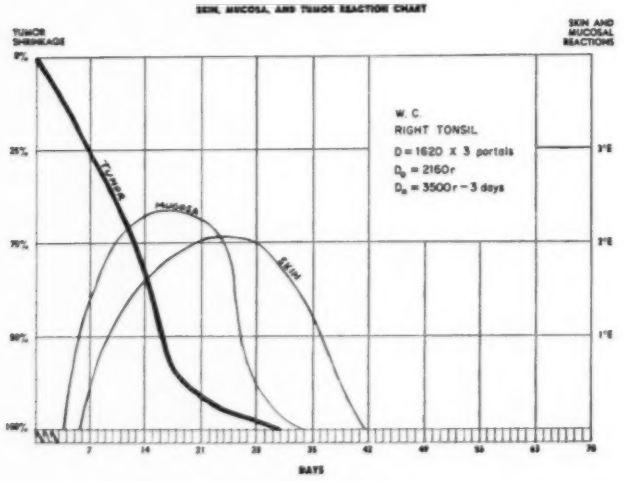

Fig. 6. B. Case I. Squamous-cell carcinoma of the right tonsil. Treated through three portals so that the tumor received a dose of 3,500 r in three days. The tumor shrank rapidly to full regression. The reactions of the skin and mucous membranes are depicted graphically, showing complete healing in both instances.

survival period of patients according to the anatomic location of the lesion.

A study of these survival figures reveals that cancers of the tongue and vallecula were not influenced by the accelerated technic. The fate of hypopharyngeal tumors followed the usual discouraging pattern except for 1 case which showed remarkable tumor arrest after a tumor dose of

posterior auricular portals, each directed to the right tonsil. Fields of 8 × 10 cm. were used. An air dose of 540 r was administered to each port daily, giving a daily skin dose of 720 r and a daily tumor dose of 1,160 r. By the end of three consecutive days each skin area had received 2,160 r and the tumor 3,480 r. The reaction curves and tumor shrinkage are shown in Figure 6B. The patient has been free from disease for three years. No lymph nodes have appeared. The skin is scarred, pliable and soft (Fig. 6C).

An epithelioma arising from the epiglottis showed a similar dramatic regression when treated by the rapid technic.

CASE II. *Carcinoma of the Epiglottis.* C. H., aged 65, was seen on Dec. 13, 1950, complaining of a "catch" in the left side of the throat. Examination showed a large bulky, cauliflower mass, about 3 × 3 cm., involving the left side of the epiglottis and extending to the mid-line. No enlarged nodes were felt. Histological examination revealed an epidermoid carcinoma. Using x-rays of 200 kv., filtered through 0.5 Cu, the right and left side of the neck were irradiated through 8 × 10-cm. portals from Dec. 18 through Dec. 22. The air dose was 2,875 r; each skin port received 3,235 r and the tumor 3,500 r in five days. The mass regressed completely, and there was no evidence of tumor two years later. The skin shows no unusual sequelae. There is no hoarseness or dysphagia (Figs. 7 A, B, and C).

Fig. 6. C. Case I. The skin healed without undue scarring or late sequelae. This photograph was taken thirty-five months after treatment had been given.

DISCUSSION

Soon after our investigations were begun, it was learned that certain biological time/dose formulae were irreversibly damaging the mucosa. It meant, therefore, that these doses had to be abandoned despite the fact that they were destroying malignant tumors. The optimum formula must be one that will destroy tumor yet permit complete healing of the mucosa. Although the undesirable reactions appeared in only 6 patients, too few in number to permit conclusive evidence, nevertheless their repeated appearance was avoided. By trial and error, over a limited range of time/dose formulae, it became

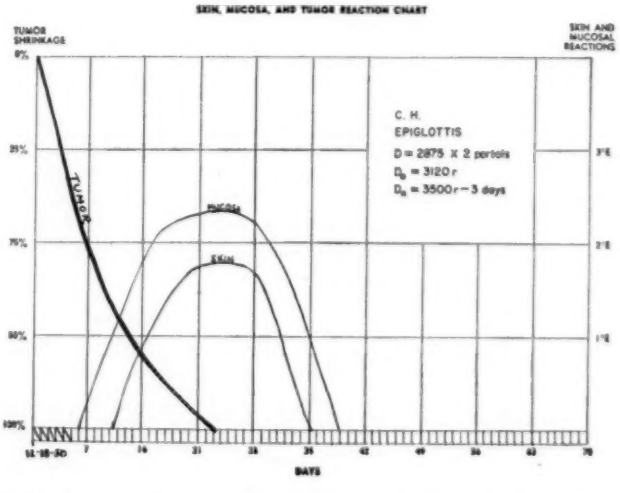

Fig. 7. A. Case II. Skin, mucosa, and tumor reaction chart of patient with squamous-cell carcinoma of the free end of the epiglottis. Treatment was given in December 1950 through two portalsf or a tumor dose of 3,500 r in five days. The reactions of the skin and mucosa behaved normally. The patient is well and free of the disease, with no voice changes.

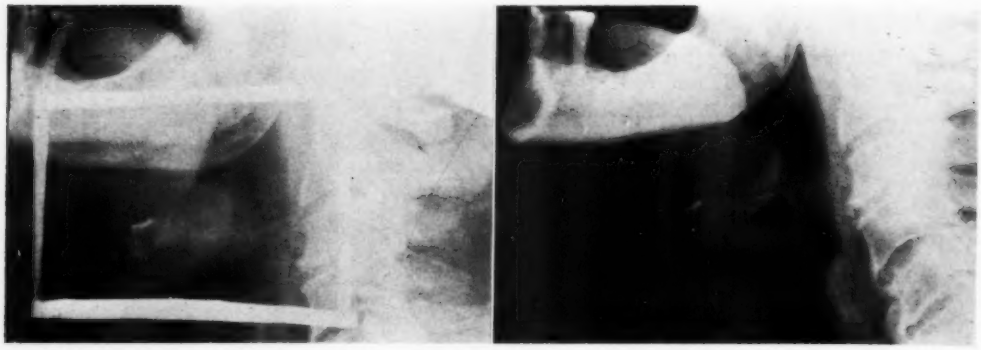

Fig. 7. B. Case II. (left) A lateral roentgenogram of the neck which clearly depicts a huge bulky exophytic tumor arising from the tip and posterior surface of the epiglottis. Although the film gives the impression of interference in the airway, breathing actually was not impaired. The cartilage of the epiglottis was intact. The opaque lead marker indicates the size and location of one of the treatment portals. (right) A lateral roentgenogram after treatment showing complete regression of the tumor of the epiglottis.

Fig. 7. C. Case II. Photograph taken twenty-two months after a skin dose of 3,200 r in five days showing the healed skin. The skin is scarred, but is soft and pliable.

evident that a tumor dose of 3,500 r delivered in three, four, or five consecutive days constituted a treatment prescription which avoided irreversible mucosal changes.

Reactions on the skin and mucous membranes reached maximum intensity long after treatment was completed. The pattern of reactions, as long as they were not more severe than that obtained with conventional technics, showed the same rise and fall. In elderly debilitated patients, or in patients who co-operate poorly, it is advantageous to administer all irradiation within a period of three to five days before any uncomfortable reactions appear. Hospitalization, if necessary, is materially shortened.

Survival statistics are distorted by the fact that advanced bulky tumors were treated. Malignant tumors of the tongue and hypopharynx yielded poor results. The three-year survival rate in cancers of the tonsil and nasopharynx is encouraging.

CONCLUSIONS

1. Experiences with a rapid irradiation treatment of 30 advanced intra-oral tumors have been described.

2. After trial and error, a time/dose treatment formula of 3,500 r delivered in three to five days has been established as safe and efficient.

3. The epithelitis reached maximum intensity between the fourteenth and twenth-first days, and usually healed by the thirty-fifth day.

4. The epidermitis, after showing maximal reactions between the twenty-first and twenty-eighth days, often healed by the thirty-fifth day. No undesirable sequelae have been observed up to a period of three years after treatment.

5. The maximal mucosal reaction was reached about seven days before the height of the skin reaction.

6. There is a probability, based on these preliminary investigations, that tumors of the oral cavity which are radiosensitive and radiocurable by conventional methods of roentgen therapy may be similarly controlled by smaller doses delivered over a shorter period of three to five days.

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SUMARIO

Observaciones con una Técnica de Irradiación Rápida en el Carcinoma Oral

El objeto de la investigación clínica aquí descrita era determinar la posibilidad de tratar el cáncer de la cabeza y del cuello con dosis tumor letales durante un breve período de tiempo. Desde la iniciación del estudio en 1948, se han tratado 30 tumores de la cabeza y del cuello con esa llamada "técnica rápida." Según se comprobó histológicamente, todos los tumores eran carcinomas epidermoideos de varios grados de diferenciación. Con la técnica descrita, los casos fueron tratados a través de puertas cutáneas múltiples sin conos intraorales.

Probando y cambiando, con una serie limitada de fórmulas de tiempo/dosis, se estableció como inocua y eficaz una dosis de 3,500 r administrada en tres a cinco días. La epitelitis alcanzó su intensidad máxima entre el décimocuarto y el vigésimoprimer días, sanando habitualmente para el trigésimoquinto día. La epidermitis, después de revelar reacciones máximas entre el vigésimoprimero y el vigésimoctavo días, sanó a menudo para el trigésimoquinto día. No se han observado secuelas adversas en un período que abarca hasta tres años después del tratamiento. La reacción mucosa máxima se presentó unos siete días antes del acmé de la reacción cutánea.

A base de esas investigaciones preliminares, existe la probabilidad de que pueda dominarse en forma semejante con dosis más pequeñas administradas en un período más breve de tres a cinco días a los tumores de la cavidad bucal que son radiosensibles y radiocurables con los métodos convencionales de roentgenoterapia.

Studies on the Dosimetry and Bactericidal Effects of Gamma Radiations from a Cobalt^{60} Source[1,2]

SAMUEL A. GOLDBLITH, PH.D., BERNARD E. PROCTOR, PH.D., SOL DAVISON, PH.D., DAVID A. LANG, S.M., BILLY KAN, S.M., CHARLES J. BATES, B.S., and MARCUS KAREL

SINCE 1943 THE Department of Food Technology at the Massachusetts Institute of Technology has been conducting studies on the effect of ionizing radiations, produced by particle accelerators, on microorganisms. The object of these studies has been to investigate the fundamental changes involved and, if possible, to establish a basis for ascertaining the feasibility and the practicability of sterilization of foods without the application of heat. Since 1950 research has been underway in these laboratories to evaluate the possibility of utilization of waste fission products as sources of radiation.

As a source of ionizing radiations a kilocurie of cobalt^{60}, a "mock" fission source, has been prepared by the Reactor Division at the Brookhaven National Laboratories. The use of cobalt^{60} for experimental studies is predicated at this time on (*a*) the ready availability of cobalt^{60} in multicurie source form and (*b*) its desirable and well defined physical characteristics of energy, half-life, and the like. As this investigation progresses it is hoped that the actual concentrated fission by-products may be available in the near future for experimental use.

The cobalt^{60} used in this investigation has been well described by Manowitz, in 1951, and will not be described in any great detail here except to state that it is a hollow cylinder of cobalt 13.5 inches long and 2.3 inches in outer diameter, covered by aluminum. The entire source is encased in lead, as indicated in Figure 1.

DOSIMETRY OF SOURCE

The source has been calibrated by three different technics, which will be described in greater detail in a separate publication. The three dosimeters used for the calibration are (*a*) an adiabatic calorimeter of the type described by Hochanadel and Ghormley (1952), (*b*) a methylene blue dosimeter as described by Goldblith *et al.* (1952), and (*c*) a ferrous-ferric dosimeter described by Miller (1950), Hardwick (1952), and Weiss (1952).

The adiabatic calorimeter was designed and built by Dr. Davison and is illustrated in Figure 1. Essentially it is a glass vial of a physical arrangement that duplicates the actual geometry of the samples to be irradiated. The vial containing purified water is thermally insulated.

Five calibration runs have been made with this dosimeter, and the results show close agreement.

In addition, dosimetry has been effected by use of the destruction of methylene blue (Goldblith, Proctor, and Hammerle, 1952) and by the use of the ferrous-ferric reaction. The dose rates, as determined, are summarized in Table I. These data show that the dose rates as obtained from the kilocurie cobalt^{60} source fall within the limits of 2,100 $\pm$ 300 rep_{83} or 1,900 $\pm$ 300 rep_{93}[3] if neither of the two assumed values for ferric ion yield indicated in the table—15.4 μM according to Weiss (1952) and 20.2 μM according to Miller (1950) and Hardwick (1952)—is preferred. There

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[1] Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952. The work reported herein has been performed under Contract AT(30-1)-1164 with the U. S. Atomic Energy Commission.

[2] Contribution No. 145 from the Department of Food Technology, Massachusetts Institute of Technology, Cambridge, Mass.

[3] Two energy equivalents for the rep are commonly assumed, 83 and 93 ergs per gram, respectively. Which equivalent is used is not of great significance so long as the same value is used consistently and the value used is stated.

TABLE I: DOSE RATES OF COBALT^{60} SOURCE DETERMINED BY VARIOUS DOSIMETRIC METHODS
(Corrected to March 1952)

Dosimeter	Dose rates: rep_{83}/min.	Dose rates: rep_{93}/min.
Calorimeter	1,820	1,640
Ferrous-ferric		
15.4 μM*	2,400	2,140
20.2 μM*	1,830	1,640
Methylene blue†	2,120	1,890

* Per liter per 1,000 rep_{93}
† $D_0 = 3.44 \times 10^5$ rep_{93}

seems to be more support for the assumption that the ferric ion yield is equal to 20.2 μM per liter per 1,000 rep_{93}. In this case, the calorimeter, ferrous-ferric, and methylene blue values support the value 1,900 rep_{83} or 1,700 rep_{93} within about ± 5 per cent. In any event, the mean value 2,100 rep_{83} or 1,900 rep_{93} would satisfy results, within ± 15 per cent, obtained by all three methods regardless of which value of ferric yield is used.

TABLE II: RELATIVE RADIOSENSITIVITIES OF 11 SPECIES OF BACTERIA EXPOSED TO GAMMA RAYS OF KILOCURIE COBALT^{60}
(10^8 organisms per ml. initial concentration)

Organism	t_{D_0} values* (min.)
Escherichia coli	6.5
Aerobacter aerogenes	4.8
M. pyogenes var. aureus	20
M. pyogenes var. albus	13
Streptococcus faecalis	28
Serratia marcescens	4.3
Corynebacterium xerose	18
Ps. fluorescens	2.8
Ps. aeruginosa	2.7
Sarcina lutea	15
Bacillus thermoacidurans	39

*Time in minutes required for 63 per cent inactivation of the sample.

The calorimetric dosimetry values were determined in August 1952 and the chemical dosimetry values in April of the same year, but in all instances the results have been normalized to March 1952. Runs made later with a ferrous solution in the calorimeter itself gave results (corrected for absorber difference) that showed no change from results obtained during runs made in the routine sample holder.

For routine use, the ferrous-ferric dosimeter appears most suitable. It is easily

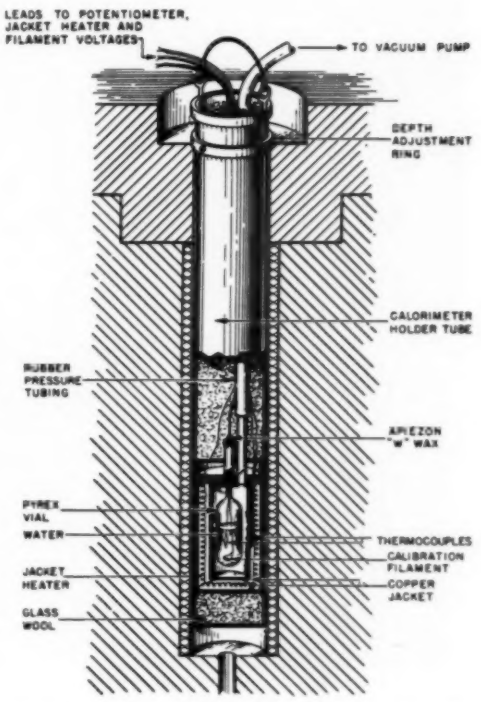

Fig. 1. Sketch of adiabatic calorimeter used for calibration of the cobalt^{60} source, showing it in place in the source.

used and gives accurate, reproducible results.

The methylene blue dosimeter has given results consistent with other determinations. By virtue of its great simplicity in application, it shows promise as a dosimeter, although an increase of precision is desirable.

The adiabatic calorimeter is not suitable for routine dose measurements because of the time involved in its use. However, it has proved satisfactory in primary determination of dose rate of the cobalt^{60} source.

The results of this research tend to support the value of 20.2 μM per liter per 1,000 rep_{93} (Miller, 1950; Hardwick, 1952) for the ferrous-ferric yield. As these results are at variance with those of Hochanadel and Ghormley (1952), further research on the dosimetry of the cobalt^{60} source by means of ionization chambers is in progress.

Fig. 2. Inserting lucite carrier containing vials of samples into the cobalt[60] source by means of a modified fishpole.

MICROBIOLOGICAL DATA

The bactericidal effects of cobalt[60] radiation have been studied. Twenty-four-hour cultures (except in the case of spore-forming organisms) in nutrient broth have been used. Samples of 5 ml. each have been aseptically pipetted into 5-ml. thin-walled Kimble glass vials and heat sealed. These vials were then placed in a Lucite carrier, which was inserted into the source by use of a modified fishpole (See Fig. 2).

Standard plate count technics have been used for evalution of the bactericidal effects of the cobalt[60] radiations. Some 1,630 separate irradiations have been made on 11 bacterial species, giving a total of more than 3,000 countable bacterial plates. From data representing between 100 and 400 survival plates from each organism, statistical-regression-survival curves have been calculated by the least-squares method.

The relative radiosensitivities of the 11 organisms studied have been determined from these regression curves and are represented in Table II by the t_{D_0} values, that is, the time in minutes required to reduce the concentration of organisms to 37 per cent of the original value. It will be observed that the spore-forming organism *B. thermoacidurans* is much more radioresistant than some of the non-spore-forming organisms, such as *E. coli* or *A. aerogenes*.

Still another way of expressing the relative radiosensitivities is based on the fact that the radiation death rate is an exponential function, following the equation:

$$n/n_0 = e^{-D/D_0}$$

where n/n_0 is the fraction of organisms surviving a dose D and D_0 is the mean lethal dose or 37 per cent survival dose. This is analagous to experience found with heat processing. In heat processing, the time required for the survival curve to pass through one log cycle is used as an index of the heat sensitivity of the organism. Accordingly, since experimental evidence is available that both types of processing, that is, heat and radiation, result in exponential survival curves of similar pattern, it is possible to use the time required for the bacterial count to pass through one log cycle as an indication of relative radiation resistance. This is called the "Z value." These data are presented in the second column in Table III.

Having these slopes available, one can also predict the times required for so-called "sterility doses" by extension of the survival curves until intersection with the X-axis at some probability of survival of 10^{-4} or fewer bacteria per ml. The validity of the extension of the survival curve to 10^0 bacteria per ml. can be checked experimentally. This has been done, and the results are also presented in Table III. The agreement obtained, as may be seen from the table, is excellent.

From fundamental data of these types, plus data from other studies being conducted on the effects of the media, concentration of organisms, and the like, one should eventually be able to predict proc-

TABLE III: "STERILITY" DOSE—EXPERIMENTAL VS. CALCULATED

Organism	Z value*	Minutes to reduce from 10^8 orgs/ml. to: 10^0 orgs/ml. Calcd.	10^0 orgs/ml. Found	10^{-4} orgs/ml. Calculated
E. coli	15.6	125	120	187
A. aerogenes	10.8	87	90	130
S. aureus	46.2	370	360	555
S. albus	29.6	237	180–240	356
S. faecalis	64.5	516	>420	775
S. marcescens	10.0	80	80	120
C. xerose	42.7	342	300	513
Ps. fluorescens	6.9	52	50–60	87
Ps. aeruginosa	6.6	53	70–80	80
S. lutea	31.0	248	240–300	373
B. thermoacidurans	86	680	≫360	1,040

* Minutes required for survival curve to pass through one log cycle.

essing times required for radiation sterilization, as is now done in heat sterilization.

From a practical point of view it is highly desirable to obtain evidence on the relative bactericidal effects of different types of radiation, which may be of use in food and drug sterilization. Experimental studies of this phase are now being conducted in these laboratories. However, sufficient evidence has not yet been accumulated to present at this time but will be presented at some future date. The importance of proper dosimetry in this respect is obvious. Further research on the dosimetry of our radiation source by ionization means is underway.

SUMMARY

1. The dosimetry of a kilocurie source of cobalt^{60} has been described.

2. The relative radiosensitivities of 11 bacterial species to the gamma rays of cobalt^{60} have been presented.

3. Relative sterility dose requirements have been found both experimentally and by calculation, and the results are in substantial agreement.

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SUMARIO

Estudios de la Dosimetría y los Efectos Bactericidas de los Rayos Gamma Procedentes de un Foco de Cobalto^{60}

El objeto de los estudios descritos era investigar las alteraciones fundamentales que ocurrían y, si era posible, establecer una base para averiguar si era factible esterilizar los alimentos sin la aplicación del calor. Para la obtención de los rayos yonizantes, se utilizó un kilocurie de cobalto^{60} como foco "ficticio" de fisión.

Preséntanse las relativas radiosensibilidades de 11 especies bacterianas a los rayos gamma del cobalto. El microbio esporógeno, *B. thermoacidurans*, es mucho más radiorresistente que algunos de los que no forman esporas, como la *E. coli* o el *A. aerogenes*.

Se han determinado tanto experimentalmente como por cálculos los requisitos que debe cumplir la dosis de esterilidad relativa, y los resultados concuerdan substancialmente.

DISCUSSION

Marshall Brucer, M.D. (Oak Ridge, Tenn.): There are two problems on which I would like to have Dr. Goldblith comment. The first is the very practical question which arises in every discussion of the sterilization of foods by radiation. The sterilization of foods could be an extremely important field for radiation if it works. Bacteriologists, however, always bring up the question of the definition of a sterilization dose. If we defined sterilization dose as that dose which kills all bacteria, then the radiation dosage is a very large number of roentgens. On the other hand, the dosage required to destroy the quality of food requires a smaller number of roentgens. Radiation cannot be a feasible method of cold sterilization unless some modifying factors are introduced. What is the definition of the sterilization dose in the food industry? Does it mean the destruction of all bacteria or only a partial destruction as shown on Dr. Goldblith's slides?

The other question is regarding the use of the chemical dosimeter. Chemical dosimetry could be very useful in clinical dosimetry problems, especially with internally administered isotopes. We are, in our own laboratories, attempting to use some of these methods but have come up against certain problems. One is the question of the wave-length dependency at the lower energy levels and especially with the sodium bicarbonate system. Another problem is, what is the practical sensitivity of chemical dosimeters? Some of our measurements have indicated that we would probably only be able to measure areas of very high radiation dosage and would not be able to use chemical dosimetry in the range of clinical application.

G. Failla, Sc.D. (New York City): In the use of a calorimeter to determine the dose in terms of energy absorbed, it is important to bear in mind that the absorption of radiation must take place in the same medium and under the same conditions in which the object of interest is to be irradiated. It would not do to determine the energy absorption in a piece of lead in the cobalt sleeve, to measure the energy dose that a water solution of a compound would receive. In fact the heat measurement must be made using as nearly identical containers and contents as is possible. If necessary corrections must be made for any energy that may go into chemical change rather than heat.

Dr. Goldblith and I have discussed this problem recently with the idea of making ionization measurements applicable to the calorimeter and chemical systems. It will be interesting to compare the results of dose measurements made with a calorimeter and an ionization method.

Dr. Goldblith (*closing discussion*): I will try to recall the points that have been brought up. In the first place, there is no such thing as absolute sterility because if one plots the log of the surviving fraction of organism *versus* time one gets a straight line.

Obviously, therefore, one never gets down to zero bacteria, but rather a probability of survival that is very low. The important thing is that one can get down to something which approaches commercial sterility. In canning, one gets down to where approximately one can spoils in 1,000 or 10,000.

To answer the question as to the dose required to achieve that degree of sterility, in the paper prepared for publication, I have "sterility" in quotation marks. In order to achieve the degree of sterility mentioned above, the dose required is in the order of two million r. Obviously the point made by Dr. Brucer is quite good.

There are undesirable changes that take place. This is why this thing has not just sprung forth and gone on in an ascending crescendo, and work is now going on to prevent or minimize some of these undesirable side-effects.

EDITORIAL

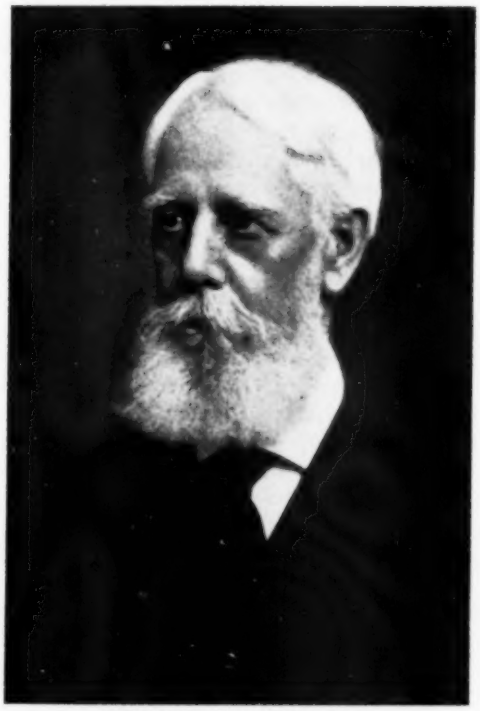
Francis Henry Williams, M.D.

1852–1936

It is well for radiologists to remember and to pay tribute to those pioneers who laid the foundation and cornerstone of modern radiology.

In 1852, one hundred years ago, Francis Henry Williams was born in Uxbridge, Mass. At the age of twenty-one he was graduated from the Massachusetts Institute of Technology. In 1877, he received the degree of Doctor of Medicine from Harvard University, and the following two years he devoted to medical study in Europe. In 1879, he began his career as a practicing physician in Boston. At the Harvard Medical School, he was appointed successively, Instructor in Materia Medica and Therapeutics, and Assistant Professor of Therapeutics.

In 1892, Dr. Williams had initiated bacterial examination at the Boston City Hospital, where he was visiting physician, and in 1894 he was the first in his community to use antitoxin in the treatment of diphtheria. It is, therefore, easy to appreciate his interest and vision in pursuing the field of radiology following the discovery of roentgen rays in 1895 and of radium three years later.



FRANCIS H. WILLIAMS, M.D.

He began his work with roentgen rays in 1896, transporting many of his patients to the Rogers Laboratory of Physics at the Massachusetts Institute of Technology to examine them with the fluoroscope. Eventually, a small room in the basement of the Boston City Hospital was provided for this purpose by the Trustees.

Previous clinical experience definitely influenced the attitude of this physician toward the status of the roentgen examination in diagnostic problems. To his mind, such a procedure involved as close a clinical relationship as does palpation, auscultation, or percussion.

By 1898 he had publicly discussed the application of roentgen methods in the diagnosis of thoracic aneurysm, pericardial effusion, cardiac hypertrophy, pulmonary tuberculosis, emphysema, and many other intrathoracic conditions. In 1899, he began his work with Dr. Walter B. Cannon and carried out some of the very early investigations on the human alimentary tract.

This pioneer very early gave heed to protecting himself and his patients from the rays emanating from the x-ray tube. He reached the completion of his long and useful career without physical blemish resulting from untoward effects of radiation either from x-rays or radium.

He, with the able co-operation of his friend, Dr. William Rollins, was instrumental in the production of many devices; among them, the fluorometer, for the mensuration of x-rays (1902) and radium salts (1903); the "see-hear," a fluoroscopic screen combined with a phonendoscopic diaphragm for noting intrathoracic sights and sounds simultaneously; and a mechanical stereoscopic fluoroscope involving the use of two disks rotating on one shaft.

Because of his early training in therapeutics, this radiologist was fascinated with radiotherapy. In his eighty-fourth year, he published a small volume on "Radium Treatment of Skin Diseases, New Growths, Diseases of the Eyes and Tonsils." He had early revealed a flair for writing and in 1901 the first of three editions of his fine book, entitled "The Roentgen Rays in Medicine and Surgery," was published. This book remains as a monument to an extraordinarily useful life of over eighty-four years. He was well known in the medical centers of the world. He was a life member of the Corporation of the Massachusetts Institute of Technology and for twenty-five years a member of its Executive Committee. He was an Honorary Member of many societies, one of them the Radiological Society of North America.

During his later years, he frequently did not appear at meetings of scientific bodies of which he was an honorary member. One of the last occasions was his attendance at the 25th Annual Meeting of the American Roentgen Ray Society, at which he delivered an address entitled "Reminiscences of a Pioneer in Roentgenology and Radium Therapy." In 1930, he retired from active practice, but he continued his personal contributions to the literature. The life of this great physician was terminated on June 22, 1936.

Dr. Percy Brown has aptly said that "the life of Francis Henry Williams has added both lustre and dignity to the science of radiology and affords stimulation to those who would help to perpetuate its ideals in like manner."

EUGENE P. PENDERGRASS, M.D.

Teletherapy Evaluation Board

In the spring and summer of 1952, twenty medical schools and the Medical Division of the Oak Ridge Institute of Nuclear Studies joined forces in a program designed to "investigate, develop and evaluate radioisotopes for teletherapy." A Teletherapy Evaluation Board composed of one representative from each participat-

ing school has been organized. The funds supporting the board are furnished in part by the medical schools and in part by the Oak Ridge Institute of Nuclear Studies under its contract with the United States Atomic Energy Commission.

The program of the Teletherapy Evaluation Board will explore initially the possibilities of utilizing three isotopes for teletherapy devices—Europium^{152}, Cesium^{137}, and Cobalt^{60}. An effort will be made to exploit the inherent physical advantages of each isotope so that a variety of unit designs may be possible. A prototype unit incorporating extensive mechanical innovations so as to investigate to the fullest all the possibilities of both rotational therapy and more conventional technics has been designed and is being constructed. It has been designed so that any of the isotopes in question could be used. This prototype unit will be studied exhaustively by the physicist and radiotherapist members from the various participating medical schools. From their study a unit design will be evolved which will be suitable for clinical therapy purposes.

By far the most important function of the Teletherapy Evaluation Board is to evaluate the method of therapy. The pros and cons of the suitability of the various isotopes and the minor differences of design have only a passing importance. The essential feature of the program is the evaluation of the method by a group effort. The plan calls for each participating school to devote only a portion of the use of its isotope machine to the evaluation program; a large portion is to be used entirely at the discretion of the radiotherapist in charge to follow his own line of clinical investigation. By pooling clinical experience a variety of technics can be utilized and properly evaluated with statistical significance. Instead of waiting years for analysis of a technic or dosage schedule because of lack of statistically significant numbers, in a relatively short time by proper organization and co-operation, a large series can be studied and definitive conclusions drawn.

The program is planned as a long-term effort, and while the deliberations of the Teletherapy Evaluation Board will be open to any of its professional colleagues it is not expected that results will be available for many years to come.

MARSHALL BRUCER, M.D.
Chairman, Executive Committee,
Teletherapy Evaluation Board

ANNOUNCEMENTS AND BOOK REVIEWS

NEW YORK ROENTGEN SOCIETY

The following officers of the New York Roentgen Society for the year 1953–54, will take office Sept. 1: Irving Schwartz, M.D., President; Harold W. Jacox, M.D., Vice-President; Jacob R. Freid, M.D., Secretary; Sidney Rubenfeld, M.D., Treasurer.

CANADIAN ASSOCIATION OF RADIOLOGISTS

At the Annual Meeting of the Canadian Association of Radiologists held in Toronto, Jan. 29, the following executive officers were elected for the current year: Dr. R. A. Macpherson, Winnipeg, Manitoba, President; Dr. J. W. McKay, Montreal, Quebec, Vice-President; Dr. D. L. McRae, Montreal, Honorary Secretary-Treasurer; Dr. Guillaume Gill, Montreal, Associate Honorary Secretary-Treasurer.

INTERNATIONAL CONVENTION OF X-RAY TECHNICIANS

The 1st International Convention of X-Ray Technicians will be held at the Royal York Hotel, Toronto, Canada, June 28–July 2, 1953. This meeting is sponsored jointly by the Canadian Society of Radiological Technicians and the American Society of X-Ray Technicians.

Refresher Courses will be offered for two hours each morning. Eight courses will be presented, four by Canadian and four by American instructors. These courses are designed for beginners as well as advanced technicians. Persons interested in the courses should write Beatrice Hurley, R.T., Registrar, St. Catherine Hospital, East Chicago, Ind., for additional information and advanced enrollment.

Afternoons will be devoted to joint sessions of the Canadian Society of Radiological Technicians and the American Society of X-Ray Technicians. Technical papers and essays will be given by technicians of both societies and by distinguished radiologists.

Two memorial lectures will be delivered, one by Dr. E. A. Petrie, of New Brunswick, Canada, and the other by Dr. Russell H. Morgan, M.D., Baltimore, Md.

Letters to the Editor

RADIOLOGICAL CONTRIBUTIONS TO THE MANAGEMENT OF PULMONARY TUBERCULOSIS

To the Editor of Radiology

DEAR DR. DOUB:

In a recent article entitled "Radiological Contributions to the Management of Pulmonary Tuberculosis" (Friedman, P. S.: Radiology **60:** 202, 1953), the author makes some statements which are so at variance with modern radiological findings that I am constrained to send this letter.

The author states that

> "The reinfection lesions may be subdivided into exudative, caseous pneumonic, fibrotic, fibro-exudative and fibro-caseous. It is essential to establish these features, since they in essence indicate prognosis and management. While it is true that some cases require serial film study . . . to determine activity, the great percentage of cases can be classified as active or inactive on the basis of roentgen anatomic and pathologic findings from a single study. On occasion, radiologic evidence indicates active pulmonary tuberculosis when all available clinical and laboratory data, including sputum analysis, suggest inactivity."

It seems to me that it has been shown by Birkelo, Chamberlain *et al.* (J.A.M.A. **133:** 359, 1947), by Garland, Miller, and Zwerling (Radiology **52:** 309, 1949), by Zwerling, Miller, Harkness, and Yerushalmy (Am. Rev. Tuberc. **64:** 249, 1951), by Chamberlain, Rigler, and Newell (to be published), and finally by such outstanding phthisiologists as Harkness, Hinshaw, and Shipman (Radiology **58:** 161, 1952) that:

1. It is not possible with any consistency in a large number of cases to diagnose *activity* from a single x-ray examination of the chest.
2. The prognosis of a given lesion cannot as a general rule be determined from a single roentgen examination; indeed, it is often difficult to determine activity from two serial films.
3. The radiodiagnostic terms "exudative, caseous pneumonic," etc. are not reproducible, have little significance, and no clinical usefulness. Of the many readers we have tested, none have been consistent in their use of any descriptive term as applied to a lesion seen by x-ray. If upon rereading the same films we cannot be consistent in our descriptive terminology, we may question the accuracy of such terminology. Reliable statistical methods must be used, and if used, will demonstrate the startling lack of consistency.
4. The modern clinical care of the patient with pulmonary tuberculosis requires that *all* aspects of a case be considered before attempting to reach a conclusion as to activity or in activity, progression or regression. These aspects include competent radiological interpretation of the x-ray findings, as well as competent clinical, bacteriological, and other forms of examination.

It is to be hoped that the readers of RADIOLOGY will not fall into what might be termed the 1903

school of radiological deduction as a result of the publication of the above-named article.

Yours sincerely,

L. H. GARLAND, M.D.

To the Editor of Radiology

DEAR DR. DOUB:

I was very glad to read Dr. Garland's letter and see evidence of his continued interest in this problem. His letter further serves to emphasize the distinction between screening or survey radiology of the chest, and clinical radiologic chest study. To confuse the two is to do an injustice to clinical radiology.

I still wish to emphasize that I believe clinical radiologic investigation of the chest with respect to pulmonary tuberculosis is a valid activity for radiologists

I welcome this opportunity to answer his letter because I feel it will serve to emphasize a basic concept in radiology—the concept that radiologic investigation is a personalized clinical study. In the application of this concept to chest disease, it is implicit that a single postero-anterior projection of the chest should not serve as the basis for clinical radiologic conclusions. As applied to pulmonary tuberculosis, study of the chest should include fluoroscopy, film projections in multiple planes, followed by such localized apical studies (in some cases, varying angled views of the apex may be necessary) and high contrast studies as are required in each problem. Body section study is also used as indicated. This is followed or associated with clinical correlation. Dr. Garland's comments may be applicable to a screening study of the chest, but certainly not to clinical radiologic study.

I should like to discuss Dr. Garland's remarks in sequence.

In quoting a paragraph from my recent article, he neglected to include a significant portion of the third sentence. It should read "while it is true that some cases require serial film study, *including body section roentgenography, as well as complete clinical data* to determine activity, the great percentage of cases can be classified as active or inactive on the basis of roentgen anatomic and pathologic findings from a single study." The inclusion of the deleted portion diminishes the validity of some of Dr. Garland's criticisms. A single study in this reference is not a dorsoventral projection but is the above-described detailed study.

Dr. Garland makes reference to several papers with which I am acquainted. I think they are of great interest, represent careful efforts, but have limited application to clinical radiologic study of the chest. They simply demonstrate that under certain conditions a postero-anterior film is not an adequate way of evaluating or even finding a pulmonary tuberculous lesion. I would agree with that.

Dr. Garland indicated those papers showed "it is not possible with any consistency in a large number of cases to diagnose activity from a single x-ray examination of the chest." Since this conclusion was based on a single film, it has no general applicability.

Furthermore, these studies are merely demonstrations of a universal human characteristic—fallibility whenever judgment is exercised. Merely because we make errors when we exercise judgment is surely no reason to suspend all judgment.

Portions of these studies involved only positive or negative conclusions. This does not occur in clinical practice as an invariable technic. On many occasions, one is in doubt and reliance is placed on further study or additional data.

Mention was made in these articles of the time consumed viewing films. One viewer was able to study 400 films in one hour. The type of study I am referring to involves careful scrutiny of lesion contours, shape and characteristics, sometimes under magnification; it includes the making of serial measurements when indicated. Surely, these two viewing technics have little in common.

I think, too, that within the framework of that study a demonstration of only 6.9 per cent under reading is a good showing. The relatively higher 12.2 per cent over-reading, which in my opinion is a salutary trend, was probably influenced by the circumstances of the study.

Another uncontrollable, but influencing group of factors are those classified by Dr. Eugene Pendergrass as psychophysiologic. These include mental attitude at the time, degree of fatigue, and technics of scanning.

For these reasons, I cannot agree with Dr. Garland's comments headed 1 and 2.

I do not agree with his comment 3. I can say from personal experience, fortified by postmortem and serial clinical evaluations, that the radiodiagnostic terms used are valid. I do not feel they are infallible. I only briefly indicated the individual features which these varying type lesions possess. It was not the intention to primarily discuss these differential diagnostic features in this paper.

I most emphatically agree with his comment 4. I repeatedly emphasized that clinical correlation is an integral part of radiologic investigation. This clinical correlation has varying weight from case to case, depending upon the radiologic data available. The paper closed with the statement, "it has not been our intention, however, to minimize the necessity of integrated teamwork and interchange of information between the clinician, the bronchoscopist, the surgeon, and the radiologist in the care of the tuberculous patient. This type of integrated teamwork is essential for most satisfactory results."

It is of note that Dr. Garland's critical comments were directed almost entirely to what was in essence the introduction to this paper.

I do not think Dr. Garland's last remark in his letter does justice to him. I do not believe, and I

do not think Dr. Garland believes, that sincere efforts to advance the contributions of radiology to the management of pulmonary tuberculosis indicate a desire to return it to its stature in 1903.

I cannot close without indicating my great admiration and respect for Dr. Garland and his fellow workers in this problem. I wish to emphasize that this letter is not intended in any way to reflect unfavorably upon their many contributions and sincerity.

Respectfully yours,
PAUL S. FRIEDMAN, M.D.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

RADIATIONS AND LIVING CELLS. AN INTRODUCTION TO RADIATION BIOLOGY, IN WHICH THE ACTION OF PENETRATING RADIATIONS ON THE LIVING CELL IS DESCRIBED, WITH SPECIAL REFERENCE TO THE EFFECT ON CELL DIVISION IN HUMAN TISSUES. By F. G. SPEAR, M.D., M.A., D.M.R.E., Member, Scientific Staff, Medical Research Council, Strangeways Research Laboratory, Cambridge. A volume of 222 pages, with 60 illustrations. Published by John Wiley & Sons Inc., 440 Fourth Ave., New York 16, N. Y., 1953. Price $3.50.

ROENTGEN, RADIUM AND RADIOISOTOPE THERAPY. By A. J. DELARIO, M.D., Member of the American College of Radiology; American Board of Radiology; Radiological Society of North America; Head of Therapeutic Radiology, St. Joseph Hospital, Paterson, N. J. A volume of 372 pages, with 65 illustrations and 155 tables. Published by Lea & Febiger, Philadelphia, 1953. Price $7.50.

ADVANCES IN CANCER RESEARCH. Volume I. Edited by JESSE P. GREENSTEIN, National Cancer Institute, U. S. Public Health Service, Bethesda, Md., and ALEXANDER HADDOW, Chester Beatty Research Institute, Royal Cancer Hospital, London, England. A volume of 590 pages. Academic Press Inc., Publishers, New York, N. Y., 1953. Price $12.00.

SANDOZ ATLAS OF HAEMATOLOGY. Written and compiled by Dr. E. UNDRITZ of the Sandoz Pharmacological Research Laboratories, under the direction of Prof. E. ROTHLIN. Translated into English by Dr. A. M. WOOLMAN. A volume of 92 pages, with 256 illustrations. Published by Sandoz, Ltd., Basel, Switzerland, 1952.

DAS ULKUS DES MAGENS UND ZWÖLFFINGERDARMS, ALS PROBLEM EINES SCHUTZSTOFFMANGELS. By Dr. H. RAMB, Chefarzt der Chirurg. Abteilung am Laurentius-Hospital, Essen-Steele. A monograph of 68 pages, with 28 illustrations. Published by Georg Thieme, Stuttgart, 1953. Agents for U. S. A., Grune & Stratton, Inc., New York, N. Y. Price DM 6.50.

DIE GESUNDE UND DIE KRANKE WIRBELSÄULE IN RÖNTGENBILD UND KLINIK. PATHOLOGISCHANATOMISCHE UNTERSUCHUNGEN. By Geb. Med.-Rat. Prof. Dr. med. et Dr. med. vet. h.c. GEORG SCHMORL (1932). Für Röntgenkunde und Klinik bearbeitet by Prof. Dr. med. habil HERBERT JUNGHANNS, Oldenburg (Oldb.). A volume of 304 pages, with 403 illustrations. Published by Georg Thieme, Stuttgart, 3d ed., 1953. Agents for U. S. A., Grune & Stratton, Inc., New York, N. Y. Price DM 72.

Book Review

TUMORS OF THE CENTRAL NERVOUS SYSTEM. SECTION X, FASC. 35 AND 37, ATLAS OF TUMOR PATHOLOGY. By JAMES W. KERNOHAN, M.D., Section on Pathologic Anatomy, Mayo Clinic, Rochester, Minn., Professor of Pathology, Graduate School, University of Minnesota, and GEORGE P. SAYRE, M.D., Section on Pathologic Anatomy, Mayo Clinic, Rochester, Minn., Instructor in Pathology, Graduate School, University of Minnesota. A monograph of 130 pages, with 126 illustrations. Published by the Armed Forces Institute of Pathology, under the auspices of the Subcommittee on Oncology of the Committee on Pathology of the National Research Council, Washington, D. C., 1952. For sale by the American Registry of Pathology, Washington 25, D. C. Price $.90.

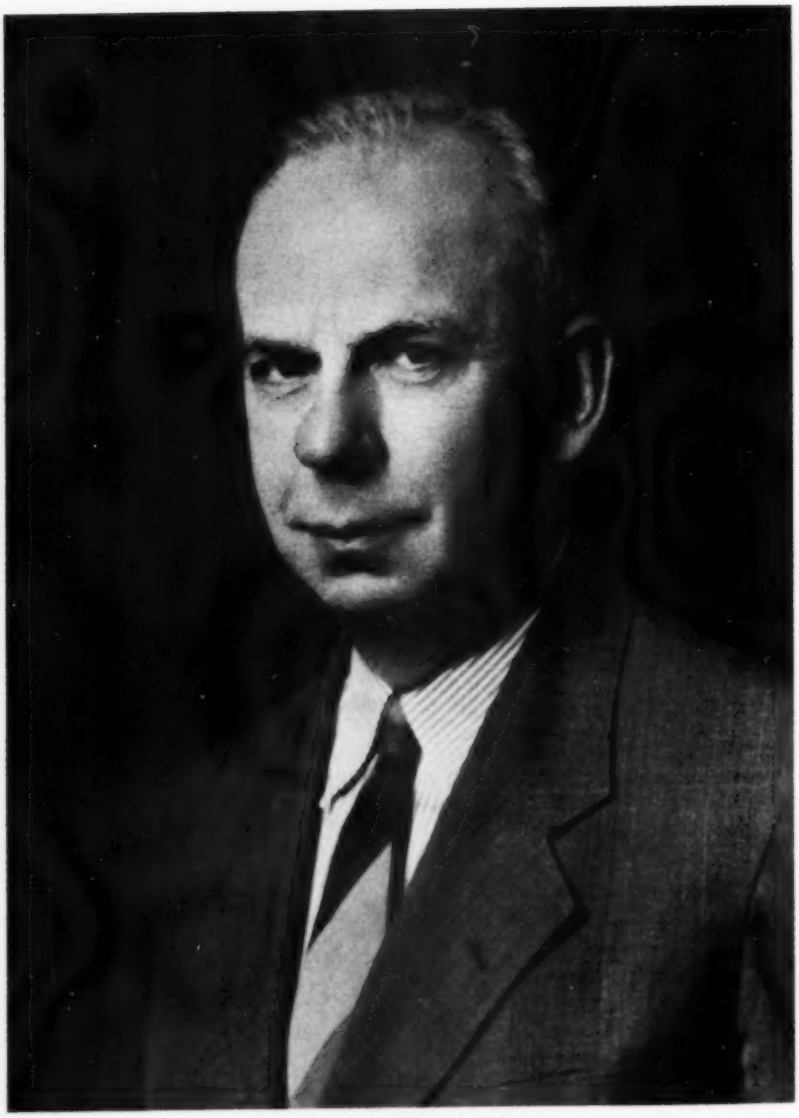
This fascicle, from a continuing series, discusses neoplasms arising within the skull and spinal canal regardless of tissue of origin. This is the first extensive text utilizing the recent classification of the gliomas proposed by the Mayo Clinic group. The classification is based on the idea that gliomas arise from pre-existing adult cells still capable of proliferation by a process of dedifferentiation. In this new nomenclature, gradation of malignancy is indicated by using the term astrocytoma, Grade 1 to 4, Grade 1 being the least malignant. In this way is delineated the close relationship of astrocytomas, astroblastomas, and glioblastoma multiforme. The point is made that there is a direct relationship between the degree of malignancy of the gliomas and the sum of the preoperative duration of symptoms plus the postoperative survival period. There is a tendency for a similar direct relationship of the ependymomas.

The atlas style of text and ample, well chosen illustration carry through the remaining tumors of nervous tissue, tumors of mesenchymal tissue and tumors of developmental defects. Tumors of the pineal body, originally projected as a separate fascicle, are included in a too brief addendum.

LEHRBUCH DER RÖNTGENOLOGISCHEN DIFFERENTIAL-DIAGNOSTIK. By WERNER TESCHENDORF, Köln, Germany. Third Edition. BAND I. ERKRANKUNGEN DER BRUSTORGANE. A volume of 954 pages, with 1030 illustrations. Published by Georg Thieme, Stuttgart, 1952. Agents for U.S.A., Grune & Stratton, Inc., New York, N. Y. Price DM 129.—

Teschendorf's book consists of four sections: diseases of the lung, the heart, the esophagus, and the diaphragm. Unlike many works which strive for completeness, one finds here no prolonged introduction to waste the student's time. The first page with its first heading "Obscuration of a Hemithorax with Increase in Volume of the Diseased Side" sets the pattern for the text as such clinical possibilities as pneumonia, childhood tuberculosis, pleural effusion, neoplasm, and giant aneurysm are presented. The second heading "Obscuration of a Hemithorax with Decrease in Volume of the Diseased Side" further illustrates and continues this scheme which finally yields 642 reproductions within 542 pages on lung disease plus another 400 pages on the heart, esophagus and diaphragm. The section on the heart provides the only three exceptions to this differential diagnosis plan with its chapters on mensuration, technic of examination and kymography.

One thus has a book in which the roentgen picture initiates the discussion, provides didactics for the student, and serves as a practical reference point should one desire ideas in the course of film interpretation. For pure reference value this may be no substitute for a definitive work like Schinz' Lehrbuch; nevertheless it is more useful to a junior radiologist by reason of its readability and its emphasis upon fundamentals. Considering a roentgenogram as an unknown, this book can be an interpretation guide. A double index contributes greatly to its value. The conventional rear index compiled by entities refers by page to the body; marginal titles on each page in the body of the book indicate the disease entity under discussion. For example, should one be studying the 20 pages on esophageal obstruction and wish to know specifically about sideropenic dysphagia, one could scan the marginal titles until that term were found. In Europe this work is considered a classic, its value in the training of a radiologist not to be questioned. It could well be a desk volume for a conscientious resident in radiology America.



ALLEN Z. RITZMAN, M.D.

IN MEMORIAM

ALLEN Z. RITZMAN, M.D.
1885–1953

Dr. Allen Z. Ritzman, a pioneer in the practice of radiology in Pennsylvania, died suddenly in Harrisburg, Penna., on Feb. 6, 1953. Although he was a semi-invalid from a severe illness, which began in October 1952, he was apparently quite well and planning to resume the practice of radiology when he was suddenly stricken and passed away.

Allen Z. Ritzman was born Aug. 12, 1885, in Gratz, Penna. His preliminary education was received in the public schools of Gratz. In 1906, he was graduated from Albright College, Reading, Penna., and in 1909, from Medico-Chirugical School of Medicine in Philadelphia. After an internship at the Harrisburg Hospital, Dr. Ritzman entered the general practice of medicine in Harrisburg. After several years he was appointed by the staff of the Harrisburg Hospital to develop the X-ray Department. He began to take an interest in radiology and was soon taking postgraduate work and devoting all his time to this specialty. Dr. Ritzman headed the Departments of Roentgenology at the Harrisburg Hospital and the Harrisburg Polyclinic Hospital until 1951 when he retired. He was then appointed honorary consultant to the staffs of both hospitals. In addition, he maintained a private office in Harrisburg and practised there until his illness in 1952. In carrying out these many duties, Dr. Ritzman directed the affairs and practices by means of a large staff of radiologists, technicians, and secretaries.

Dr. Ritzman was a Diplomate of the American Board of Radiology and a member of the Roentgen Ray Society, the Radiological Society of North America, the Radiological Society of Pennsylvania, the Philadelphia Roentgen Ray Society, the American Medical Association, the Medical Society of the State of Pennsylvania, the Dauphin County Medical Society, and a Fellow of the American College of Radiology.

He was a life-long active member of the Masonic Order, the Harrisburg Consistory, and the Zembo Shrine. He was active in the affairs of Pine Street Presbyterian Church of Harrisburg. His interest and knowledge won him national honors, and he became a recognized authority on the breeding and showing of homing pigeons. His office was filled with numerous trophies which were won by birds which he had bred and raised. He was also a great sportsman, hunter, and fisherman.

He will long be remembered not only as a competent radiologist but also for his genial personality, his friendly nature, his great humility, and his unselfish generosity.

HENRY T. SIMMONDS, JR., M.D.
WALTER P. BITNER, M.D.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, John E. Wirth, M.D., 635 Herkimer St., Pasadena 1, Calif.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 15 East Monroe, Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Calvin L. Stewart, M.D., 2330 First Ave., San Diego.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Joseph F. Linsman, M.D., 436 N. Roxbury Dr., Beverly Hills. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL SOCIETY. *Secretary*, Richard C. Ripple, M.D., 1215 28th St., Sacramento. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, William H. Graham, M.D., 634 E. Santa Clara St., San Jose 12. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Wm. W. Saunders, M.D., VA Hospital, San Francisco 21. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Wm. S. Curtis, M.D., Boulder Medical Center, Boulder. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, William A. Goodrich, M.D., 85 Jefferson St., Hartford 14. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, B. Bruce Alicandri, M.D., 20 Maple St., Springfield, Mass. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, U. V. Wilcox, M.D., 915 19th St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, A. Judson Graves, M.D., 2002 Park St., Jacksonville. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, E. Hampton Bryson, M.D., 273 Alhambra Circle, Coral Gables. Meets monthly, third Wednesday, 8:00 P.M., Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Albert A. Rayle, Jr., M.D., 478 Peachtree St. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert M. Tankesley, M.D., 218 Doctors Bldg., Atlanta. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary*, Col. Alexander O. Haff, Tripler Army Hospital, Honolulu. Meets monthly on the third Friday, at Tripler Army Hospital.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Elbert K. Lewis, M.D., 6337 S. Harvard Ave., Chicago 21. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, John A. Robb, M.D., 23 East Ohio St., Indianapolis. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, James McMillen, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and holds a scientific session in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Willis L. Beller, M.D., 700 Kansas Ave., Topeka. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Hugh Allan Smith, M.D., Eastern Maine General Hospital, Bangor. Meets three times a year—Spring, Summer, and Fall.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, H. Leonard Warres, M.D., 2337 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, James C. Cook, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, John R. Hodgson, M.D., The Mayo Clinic, Rochester. Meets in Spring and Fall.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John W. Evans, M.D., 117 N. President St., Jackson, Miss. Meets monthly, third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Sidney Rubin, M.D., 410 Professional Bldg., Kansas City, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Francis O. Trotter, Jr., M.D., 634 North Grand Blvd., St. Louis 3. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, Grant P. Raitt, M.D., 413 Medical Arts Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Nicholas G. Demy, M.D., 912 Prospect Ave., Plainfield. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 8:45 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Joseph J. La Vine, M.D., 259 North Grand Avenue, Baldwin, N. Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Harold W. Jacox, M.D., 622 W. 168th St., New York 32.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John F. Roach, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, A. Gordon Ide, M.D., 277 Alexander St. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary*, Clifford C. Baker, M.D., Harwood Bldg., Scarsdale. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, Waldemar C. A. Sternbergh, M.D., 1400 Scott Ave., Charlotte 2. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. Milton Berg, M.D., Quain & Ramstad Clinic, Bismarck. Meets in the Spring with State Medical Association and in the Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Willis S. Peck, M.D., 1838 Parkwood Ave., Toledo 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Harry K. Hines, M.D., 2508 Auburn Ave., Cincinnati 19. Meets first Monday of each month, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Richard Raines, M.D., Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Donald H. Rice, M.D., West Penn Hospital, Pittsburgh 24. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., 1037 Stuart Bldg., Lincoln, Nebr.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. Henry E. Plenge, M.D., Spartanburg General Hospital, Spartanburg. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

Tennessee

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Texas

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HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Frank M. Windrow, M.D., 1205 Hermann Professional Bldg.

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TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Jan. 29–30, 1954, in Dallas.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Cerebral Arterial Shunt. Kenneth M. Browne, W. Eugene Stern, and A. Earl Walker. Arch Neurol. & Psychiat. **68:** 58–65, July 1952.

Measurements of total cerebral blood flow have generally failed to indicate any definite vasomotor effect on the caliber of intracranial arteries following stimulation of the cervical sympathetic trunk or block of the stellate ganglion. In order to demonstrate any reapportionment of cerebral blood flow which might occur following such interference, carotid angiography was performed in eight cats. Thorotrast was used for injection of the common carotid and the animals were either immobilized with intocostrin ® or anesthetized with intravenous sodium pentobarbital. Artificial respiration was employed. Control arteriograms were made before, during, and after either stimulation or section of a cervical sympathetic trunk. The caliber of the intracranial and extracranial arteries was measured at various points on enlarged prints (×4) of the roentgenograms with a caliper.

A peculiarity of the cerebral circulation in the cat is the fact that after embryonic life the internal carotid artery is a vestigial cord without a lumen for more than a few millimeters past its origin. Hence, cerebral blood from the common carotid passes by way of the external carotid artery, internal maxillary and a rete formed in the pterygoid fossa through the orbital fissure to the cavernous sinus. Vessels here form an internal rete and then unite to form a single large artery; this enters the middle portion of the circle of Willis in much the same manner as does the internal carotid in man. It continues as the anterior portion of the circle to give origin to the middle and anterior cerebral arteries. Thus, there is a free communication between extracranial and intracranial circulations.

Cerebral blood flow in the cat is altered qualitatively by unilateral electrical stimulation of a cervical sympathetic trunk, resulting in a shunting of blood to the cerebral hemisphere contralateral to the stimulation. A shunting of extracranial blood to the intracranial circulation was demonstrated in the authors' experiments by the dilatation of certain basal intracranial arteries subsequent to the stimulation. That certain arteries on the side of stimulation (the anterior portion of the circle of Willis, together with its main branches, the anterior and middle cerebral arteries) do not dilate would seem to be evidence of increased tone of their walls due to the sympathetic excitation.

Changes in cerebral blood flow following stimulation were slow in onset, progressed after the end of stimulation and persisted for minutes. These responses are considered typical of the basal intracranial arteries. In contrast are the rapid onset and immediate cessation of response of extracranial arterioles under the same stimulation.

Twelve roentgenograms; 1 tracing.

JOHN F. RIESSER, M.D.
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Technic and Value of Percutaneous Vertebral Angiography. Donald B. Freshwater. S. Clin. North America **32:** 801–810, June 1952.

Acceptance of vertebral angiography has been slow because of the relatively infrequent indications for the procedure and the difficulty of the technic.

Indications for vertebral angiography include the following: (1) spontaneous subarachnoid hemorrhage, failing demonstration of the lesion by bilateral carotid angiography; (2) intracranial bruit under the same conditions; (3) atypical cerebellopontine angle syndromes; atypical acoustic neuromas; (4) syndromes of obscure etiology involving midbrain and hindbrain; (5) cerebellar tumors with associated vascular irregularity in fundi or a family history of hemangioblastoma.

With the patient under Pentothal sodium, the needle is introduced medial to the carotid, after which the transverse process and then the foramen of the vertebral artery are sought. The needle is advanced slowly into the foramen. Needle, open petcock, and syringe with 5 c.c. citrate solution are a unit during the puncture. Once in the artery, a syringe containing 10 c.c. of Diodrast is attached to the needle and the medium is injected rapidly. A lateral roentgenogram is made after 9 c.c. of the solution are injected. The entire procedure is repeated for stereoscopic views. Anteroposterior, submentovertex and Chamberlain-Towne projections should also be secured.

Anatomic and projection variants are discussed as pitfalls in the interpretation of the angiograms.

Complications are fewer than with carotid angiography.

Eleven illustrations, including 9 roentgenograms.

JOSEPH P. TOMSULA, M.D.
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The Change in Position of the Calcified Pineal Gland on the Roentgenogram Due to Directional Intracranial Shrinkage Following Open Brain Injuries. H. G. Drewes. Fortschr. a. d. Geb. d. Röntgenstrahlen **77:** 77–80, July 1952. (In German)

The deposition of calcareous material within the pineal gland is a physiologic process. Roentgenographically demonstrable calcifications in the pineal gland can be demonstrated in the adult in between 55 and 80 per cent of the cases. The measuring methods of Vastine and Kinney (Am. J. Roentgenol. **17:** 320, 1927) for determining the normal position of the pineal gland are well established, and the displacement of the pineal gland due to space-absorbing processes within the brain (tumors, etc.) is a well known phenomenon. Not so many reports, however, have been made about the opposite process—the displacement of the pineal gland due to shrinkage of part of the brain following an open injury. The shrinkage is directional, *i.e.*, the brain substance is distorted in the direction of the injury.

The author has studied 258 skull roentgenograms in which the pineal gland was demonstrated by its calcifications and which also revealed evidences of a marked injury to the skull, presumably associated with injury to the brain. Ninety-seven of the films showed displacement of the pineal gland. If there is an open brain injury, the skull must be fractured at the site of the injury; the dura is torn, and the brain substance is, more or less, damaged in its continuity. In the process of healing, an adhesion forms between the dura (the inner periosteum of the bony skull) and the brain. The destroyed brain tissue is replaced by mesenchymal

elements. Through the shrinkage of the scar, which is fixed at the site of the injury, a distortion of the brain occurs in the direction of the bony defect. As a result of this shrinkage a local widening of the neighboring ventricles is produced, and, if the injury is severe enough, a far reaching distortion of a large part of the hemisphere may occur. In these cases, the shadow of the pineal gland may be displaced toward the defect.

In order of frequency, most of the skull fractures studied involved the parietal bones, the frontal bones, the occipital bone, and the temporal bones. Percentage wise, the greatest frequency of distortion of the pineal gland occurred in frontal bone fractures, perhaps because in these fractures the compensating effect of the ventricles cannot be brought into play. Pineal gland displacement was found in 38.9 per cent of the fractures of the parietal bones, in 43.6 per cent of the frontal bone fractures, in 25 per cent of the occipital bone fractures, and in 27.3 per cent of the fractures of the temporal bone.

In conclusion the author states that if a displacement of the pineal gland is encountered, it may be wise to make certain that it is not due to an old injury on the side toward which the gland is displaced before making a diagnosis of a space-absorbing process on the opposite side.

Three roentgenograms.

WM. A. MARSHALL, M.D.
Chicago, Ill.

Cephalhematoma Associated with Fracture of the Skull. Norman Kendall and Henry Woloshin. J. Pediat. **41:** 125–132, August 1952.

Cephalhematoma in newborn infants results from an accumulation of blood beneath the periosteum of the skull. The present report deals with the incidence of fracture in association with this condition.

Cephalhematomas were observed in 69 of a consecutive series of 2,774 newborn infants at Temple University Hospital (Philadelphia), an incidence of 2.49 per cent. Of 64 of this group for whom skull roentgenograms were obtained, 16 (25 per cent) were found to have a fracture of the parietal bone at the site of the cephalhematoma. In each instance the fracture was observed in the lateral projection. Only rarely was it apparent in an anteroposterior or tangential view. The fracture lines were linear in type; they extended into the parietal bone from the midsagittal suture, approximately at a right angle to this suture.

Sixty-one per cent of the patients with cephalhematomas were males. Of those with fractures, 9 were males. Other studies have also indicated that cephalhematoma is more common in male infants. Forty of the cephalhematomas occurred over the right parietal bone, 17 over the left parietal bone, and in 11 instances both parietal bones were involved. Approximately 75 per cent of the infants born during the period of observation were delivered with forceps; 93 per cent of those with cephalhematomas had a history of forceps delivery. Statistical analysis of the data revealed that cephalhematomas, with or without a fracture of the skull, occurred more often in infants born to primiparous women.

Calcification of cephalhematomas occurs frequently and, following the absorption of blood, a calcified ridge may be present at the periphery. This is usually absorbed eventually, though bony deformities of the skull have been reported as permanent complications.

Two roentgenograms; 2 photographs.

HOWARD L. STEINBACH, M.D.
San Francisco, Calif.

Case of Intraventricular Epidermoid. F. Mascherpa and G. Lombardi. Radiol. med. (Milan) **38:** 660–665, July 1952. (In Italian)

This case of intraventricular epidermoid, the tenth to be recorded in the literature, is presented because of the characteristic roentgenologic appearance. Following a ventriculogram, the gas not only outlined dilated ventricles but penetrated the mass of the dermoid in a very irregular manner, giving the tumor the appearance of a sponge. Although Shapiro (Radiology **55:** 852, 1950) described a similar appearance in a glioblastoma multiforme, the spongy distribution of gas has characterized the majority of intraventricular dermoids reported up to the present time.

Three roentgenograms.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Anesthesia for Encephalography and Arteriography. Robert B. Orr. S. Clin. North America **32:** 811–816, June 1952.

The author reviews a series of 130 unselected cases examined by encephalography or arteriography, or both. In 23 cases the procedure was encephalography, in 45 arteriography, and in 62 cases a combination of the two. Pentothal sodium was administered in 103 patients, pentothal sodium plus decamethonium bromide (syncurine) in 24, and ether in 2. The average dose of pentothal sodium was 1.3 gm., and the average amount of syncurine was 2.6 mg. The average time consumed for the anesthesia was one hour. In 13 cases an endotracheal tube was introduced as part of the planned procedure, and in 3 cases as an emergency measure.

The author gives an excellent discussion of premedication from a physiological point of view. Atropine sulfate is administered one hour prior to operation. Morphine sulfate may not be given when central depression is suspected. Topical throat anesthesia with 10 per cent cocaine is used on all patients to reduce cough and spasm reflexes. It also reduces the amount of pentothal required.

Complications included laryngospasm (4 cases), cyanosis (3 cases), vomiting (2 cases), tracheal deviation from hemorrhage (1 case), apnea (1 case), and severe coughing (1 case). An acute respiratory obstruction developed a few hours after operation in 1 case as a result of laryneal edema for which a tracheotomy was necessary.

Four diagrams.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Primary Calculus of the Lacrimal Sac. Report of a Case. Sprinza Weizenblatt. Arth. Ophth. **48:** 61–65, July 1952.

A case is reported of a concretion forming in the lacrimal sac of a 28-year-old white woman during a two-year period of epiphora. The canaliculi were not involved. The concretion produced a hard nodule in the region of the lacrimal sac. Partial obstruction of the lacrimal pathways was observed clinically, but no filling defect was seen on x-ray examination following

injection of iodized oil. These contradictory findings were clarified after the operation, when the removed concretion was found to be radiopaque and of the same density and shape as the lacrimal sac in the roentgenogram. Had a film of the lacrimal pathways been taken before injection of iodized oil, the radiopaque calculus would have been seen and the correct diagnosis arrived at before the operation. The iodized oil injected into the lacrimal pathways spread as a fine layer between the mucosa of the lacrimal sac and the concretion. What appeared in the roentgenogram as the lacrimal sac filled with contrast medium was in reality the radiopaque concretion. In cases of an unusual pathological condition of the lacrimal pathways, roentgenograms before injection of a contrast medium may be of value.

Two roentgenograms; 1 photograph.

THE CHEST

Simplified Bronchography. Y. Fred Fujikawa (Note). Am. Rev. Tuberc. **66:** 246–250, August 1952.

The author describes a technic of bronchography which consists essentially of instillation of iodized oil through a cannula with the patient in the desired lateral decubitus position. Slow respiration and slow introduction of the oil are stressed. Pontocaine in 0.5 per cent solution is used in an atomizer as a local anesthetic agent. The oil is distributed throughout the bronchial tree by turning and tilting the patient.

Three photographs; 3 roentgenograms.

JOHN H. JUHL, M.D.
Minneapolis, Minn.

Indications for a Delayed Roentgenogram in Bronchography. Irving J. Kane and Saul Heiser. J. Thoracic Surg. **24:** 70–74, July 1952.

The authors point out that a delayed roentgenogram in bronchography may often prove of considerable value. Often such a film will show bronchi to be normal which were presumed to be completely obstructed on earlier films. A delayed roentgenogram may also reveal bronchiectasis which was not apparent on the film taken immediately following instillation of iodized oil.

Assuming a satisfactory technic for instillation and distribution of the contrast medium through the various segments of the bronchial tree, there are four factors which influence filling of the peripheral bronchi: (1) the physical nature of the contrast substance, (2) the volume of contrast substance used, (3) the temperature of the contrast medium, and (4) the patency of the bronchi. As a contrast agent the authors use iodized oil, since the water-soluble media are absorbed too rapidly to permit delayed films. A slight excess of the contrast substance obviates the possibility of incomplete filling due to lack of sufficient medium. Reducing the viscosity of iodized oil by heating increases its speed of flow and its ability to enter stenosed bronchi. If the oil is not warmed before instillation, a delayed roentgenogram will allow sufficient time for the oil to reach body temperature with about the same effect as preheating the oil.

A delayed roentgenogram is indicated when examination of the wet film immediately following bronchography discloses adequate contrast substance in a proximal bronchus, associated with failure to outline its peripheral branches. In the interval before taking such an additional film, the patient should be maintained, for about five minutes, in a position favoring gravitation of the contrast substance into the unfilled segments. In the latter position he should be instructed to breathe very slowly and deeply, encouraging maximum dilatation and elongation of bronchi as a further aid to entrance of the iodized oil.

Three cases are presented to illustrate the advantage of delayed roentgenograms in bronchography.

Six roentgenograms.

C. J. CORRIGAN, M.D.
St. Paul, Minn.

Bronchography in Children. D. E. S. Wishart. Ann. Otol., Rhin. & Laryng. **61:** 505–514, June 1952.

Bronchography by endobronchial injections of iodized oil through the bronchoscope under general anesthesia and under fluoroscopic observation has been performed by the author approximately 2,500 times. As from three to five bronchograms were made at each session, about 11,000 films are available for inspection. These bronchographic studies led to about 111 lobectomies and pneumonectomies for bronchiectasis in the period since 1945 alone. No serious postanesthetic complications have occurred in recent years.

Particular care is taken to see that electrical sparks do not occur during the examination. The table used is shockproof and is completely grounded. The use of wool in the draping of the patient is prohibited. View boxes and all electrical outlets are flashproof.

No sedation is given prior to bronchography. The anesthetic used is ethyl-chloride-ether sequence. Much of the success of the whole procedure depends upon the evacuation of secretions from the main bronchi by suction. After all secretions have been removed, the anesthetist increases the anesthesia and the radiologist is summoned.

Roentgenograms taken in the oblique positions are desirable because the bronchial tree divides in a direction oblique to the horizontal (when the patient is in the horizontal position).

The radiologist using the fluoroscope directs the bronchoscopist until the bronchoscope and the oil tube are in the requisite position, just proximal to opening of the bronchus to the right upper lobe. The beveled end of the bronchoscope is directed laterally. At this point the radiologist asks the nurse to inject the iodized oil slowly. He watches the upper lobe bronchi fill until they are well delineated. At his command the injection of the oil is stopped and at that moment a "spot" film is taken. This film is invariably excellent and without any flooding of alveoli. The oil tube is pushed slightly further into the right main bronchus and more iodized oil is injected. This outlines the right middle lobe and right lower lobe and when the optimum filling has occurred a second "spot" film is taken. At this moment the "spot" film will show a clear outline of the middle and lower lobes but the upper lobe will now commence to show flooding. Following this the patient is returned to the horizontal position and a postero-anterior "spot" film is taken. Then the patient is turned to the left side into the right lateral position and a lateral "spot" is taken.

For bronchography of the left lung the patient is first placed in the right anterior oblique position. After the filling of the left upper lobe great attention is paid to the proper mapping of the bronchus leading

to the lingula. The successive positions of the patient are the exact reverse of the above when the right lung is to be studied. Delineation of all parts of the lung is satisfactorily accomplished by this technic.

The patient comes rapidly out of the anesthetic and, because there has been no preoperative sedation, the cough reflex returns rapidly and the oil is expelled.

In the literature bronchography in young children is described as accompanied by certain theoretical dangers. The risk of anesthesia, the risk from the technical procedure of introducing iodized oil and that of respiratory distress due to the filling of the tracheobronchial tree are obviated by the use of the author's technic. The author has never seen intoxication due to the use of iodine.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Plate-Like Atelectasis in Exudative Pleuritis and Its Origin. J. Siemsen. Schweiz. med. Wchnschr. **82**: 702–706, July 5, 1952. (In German)

In 35 cases of fresh exudative pleuritis, the author found radiographic evidence of plate-like atelectasis in 14 (40 per cent). These along with 2 other cases are presented. The larger part of the paper deals with current views on the genesis of atelectasis. It appears that many contemporary investigators hold that, in addition to compression and obstruction atelectasis, there must be a third type produced by a spontaneous reflex contraction of a part of the lung. In support of this theory, several authors are quoted who believe they have proved that the lung is a neuromuscular organ capable of spontaneous contraction. The present author feels that pleurisy may be a stimulus to a reflex mechanism of the type mentioned.

Four roentgenograms; 6 drawings.

GERHART S. SCHWARZ, M.D.
New York, N. Y.

Triangular Hilar Shadows. Samuel C. Stein. Am. Rev. Tuberc. **66**: 188–193, August 1952

Chest roentgenograms on over 3,000 persons from birth to twenty years of age, obtained in a joint investigation by the Office of Indian Affairs and the Henry Phipps Institute of the University of Pennsylvania, revealed 10 with superior mediastinal widening associated with a triangular hilar shadow usually considered to be due to a large thymus. In 8 cases the right side the chest was involved and in 2 the left. In 3 patients unmistakable tuberculosis developed. In the remaining 7 the triangular shadow was attributed to a prominent thymus. The author feels that in the presence of triangular hilar shadows a diagnosis of tuberculosis should be considered if there is a history of contact with the disease, if there is a positive tuberculin test, and if an existing hilar node or parenchymal lesion persists for two or more years.

One roentgenogram; 1 table.

JOHN H. JUHL, M.D.
Minneapolis, Minn.

Radiological Appearances Following Haemoptysis. R. Hasting-James. J. Fac. Radiologists **4**: 44–53, July 1952.

Hemoptysis is defined as the expectoration of blood derived from the trachea, bronchi, or lungs. The present paper is not concerned with the lesions which cause hemoptysis, but deals with the radiological appearances resulting from the actual bleeding into the respiratory organs. These appearances have received little attention, but are nevertheless important, as they add another factor to be considered in the differential diagnosis of lung opacities in general, and, since opacities seen on a roentgenogram may be a mixture of shadows due to blood and shadows due to disease, the problem arises of differentiating the constituent parts.

Manifestations of clinical and radiological interest occurring after free bleeding into the respiratory tract are considered under the following headings:

1. Opacities due to blood in the lung fields, their character, distribution, and rate of clearing receiving emphasis.
2. Bleeding as a cause of spread of disease.
3. Segmental collapse of the lung.
4. Fluid levels appearing after hemorrhage.
5. Apparent tumor formation.
6. Hemopneumothorax.
7. Chronic effects, from repeated bleeding, such as brown induration, hemosiderosis, and chronic interstitial fibrosis.

Eleven illustrative cases are presented.

Twenty-four roentgenograms.

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Bronchiectasis in Childhood and Adult Pulmonary Tuberculosis. Teodosio Valledor and Antonio Navarrete. Dis. of Chest **22**: 46–54, July 1952.

This paper is based on a 15-year study of 250 cases of pulmonary tuberculosis of childhood in a sanatorium in Havana. Fifty per cent of the children in the series were under four years of age. The diagnosis was made by serial bronchoscopy and bronchography, with a technic appropriate to the age of the patient. Bronchiectasis of varying degree was found in about 70 per cent of the cases. Most commonly the bronchiectasis occurred in the right middle lobe. Next in order of frequency it involved the right upper lobe, the left upper lobe, including the lingula and lower lobes.

In the adult, bronchiectasis in tuberculosis results from intrinsic obstructive and stenotic lesions of the bronchi, leading to chronic atelectasis and retractile fibrosis.

There is, in all probability, a relation between residual bronchiectasis of the type described in pulmonary tuberculosis in the child and suppurative bronchiectasis in later life.

Twelve roentgenograms.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Incidence of Pulmonary Tuberculosis in a Group Continuously Observed and Periodically Re-examined. Fernando D. Gomez and Aristeo A. Piaggio. Am. Rev. Tuberc. **66**: 1–15, July 1952.

Periodic chest photoroentgenograms as well as indicated clinical and laboratory examinations were used in a study of state electric and telephone workers in Montevideo, Uruguay. The photoroentgenograms were taken in the years 1940, 1947, 1948, 1949, and 1950, and 1.07 per cent of the 7,650 persons examined for the first time were found to have active pulmonary tuberculosis, activity being determined by roentgenographic characteristics in all, and by bacteriologic study in approximately 65 per cent of the cases. Of 5,507 persons studied in 1947, 4,153 (79.2 per cent)

remained under observation in 1950. The incidence of latent tuberculosis detected at the end of the first year was 0.15 per cent, at the end of the second year 0.26 per cent, and at the end of the third year 0.04 per cent. The majority (97.6 per cent) of the group examined in 1940 were tuberculin-positive, so tuberculin testing was abandoned in the later studies. The majority of the latent lesions found were in persons carrying the residues of previous disease.

Seventeen cases of symptomatic tuberculosis appeared between successive routine examinations, all in the first year; they showed a progressive tendency, with 21.4 per cent mortality. On the other hand, the latent forms were mild and tended to regress. The authors conclude that the latent tuberculosis found in surveys of healthy individuals rarely represents the onset of progressive phthisis, while the lesions found in later follow-up in previously normal persons and symptomatic lesions have a tendency to be progressive.

Eleven tables.

JOHN H. JUHL, M.D.
Minneapolis, Minn.

Pulmonary Cavitation with Negative Sputum (With Reports of Eight Cases). Ellen G. Balchum and Jacob Zimmerman. Dis. of Chest **22:** 68–80, July 1952.

The authors stress the fact that cavitation is merely an expression of pulmonary pathology and is not pathognomonic of a tuberculous infection. They discuss and illustrate some of the non-tuberculous infections and non-infectious cavity-producing lesions with which patients are frequently admitted to tuberculosis hospitals. Under the heading "infectious lesions" they list resolving pneumonia, lung abscess, and fungus infection, and under "non-infectious lesions" cystic disease of the lung, neoplasm, pulmonary infarction, and trauma.

In considering the numerous pathological conditions of the lung which can produce cavitation and mimic tuberculosis, the authors do not overlook the many instances of caseous tuberculosis with persistently negative sputa over long periods of time. Before making a diagnosis of tuberculosis, however, in a patient with negative sputum and with an x-ray picture indistinguishable from that produced by tuberculosis, exhaustive studies must be made to rule out other conditions.

Twelve roentgenograms.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Contralateral Rib Fractures During Thoracoplasty. Emil Rothstein and James T. Gilboy. Am. Rev. Tuberc. **66:** 233–239, August 1952.

The authors report 5 cases of fracture of the contralateral first or second ribs following thoracoplasty. No pain or disability was noted due to the fractures, which were thought to be due to muscle imbalance resulting from rib resection. Other possible causes are cough, prolonged strain due to the patient's position during operation, and traction during surgery.

Six roentgenograms.

JOHN H. JUHL, M.D.
Minneapolis, Minn.

Guided Symphysis. Functional Prophylaxis in Exudative Pleurisy and Pneumothorax Fluid. G. Birath. Am. Rev. Tuberc. **66:** 134–150, August 1952.

It is important to prevent impairment of pulmonary function due to reduced diaphragmatic mobility in patients with pleural effusion associated with therapeutic pneumothorax and with exudative pleurisy. The author treated a series of patients by attempting to prevent pleural adhesions tending to transfix the diaphragm. The program, which he designates as "guided symphysis," consisted of (*a*) breathing exercises, with electric stimulation of the phrenic nerve in some cases, (*b*) adoption of the lateral posture with the affected side uppermost, and (*c*) frequent pleural aspiration and medication with specific antimicrobial agents. Of 48 patients with recent effusion, 40 showed good or very good ventilatory mobility after a three-month period; in 17 patients with long-standing effusion (more than three months) the results were not as good, with 10 cases showing considerable impairment despite treatment.

Fourteen roentgenograms; 3 tables.

JOHN H. JUHL, M.D.
Minneapolis, Minn.

Anatomic Relationships Between Bronchogenic Carcinoma and Calcified Nodules in the Lung. C. Eugene Woodruff, N. C. Sen-Gupta, Stuart Wallace, Paul T. Chapman, and Perry C. Martineau. Am. Rev. Tuberc. **66:** 151–160, August 1952.

The great increase in the incidence of bronchogenic carcinoma has been the subject of much study in recent years, but no agreement has been reached regarding the relative importance of a number of possible causes. The present study was undertaken to determine the relationship of bronchogenic carcinoma to areas of calcification within the lung. Of a total of 116 cases, 67 were found suitable for inclusion in the series, *i.e.*, they could be classified according to cell type and according to whether or not calcified foci were significantly associated with the tumor.

Calcified foci were found closely associated with the tumor in 79 per cent of 19 cases of squamous-cell carcinoma, in 60 per cent of 20 tumors of large-cell undifferentiated type, and in 59 per cent of 22 tumors of the small-cell undifferentiated type; only 1 of 6 adenocarcinomas showed an associated calcified focus. The calcified lesions found in these cases were largely those of tuberculosis. The tumors were in the lung adjacent to parenchymal calcification or to calcified tracheobronchial lymph nodes, and the foci of calcification were not incorporated in the tumor.

Chronic irritation of an adjacent bronchus by a calcified node, scarring of blood and lymph vessels as well as other pulmonary structures incident to the healing of a tuberculous lesion, and the presence of cholesterol, a possible carcinogen, in the old tuberculous foci are suggested as possible factors for the association of neoplasms with calcification. In addition, it has been shown that bronchiectasis, which may occur as a sequel to tuberculosis, is a probable factor in localization of tars from tobacco smoke.

The authors suggest that one reason for the increase in incidence of bronchogenic carcinoma is the marked drop of the tuberculosis death rate in young adult males, leaving a much larger population of older males susceptible to pulmonary tumors because of their calcified tuberculous foci.

Six roentgenograms; 1 chart; 3 tables.

JOHN H. JUHL, M.D.
Minneapolis, Minn.

The Postmortem Angiogram of the Lungs in Tuberculosis, Silicosis and Bronchogenic Carcinoma. J. Schoenmackers and H. Vieten. Fortschr. a. d. Geb. Röntgenstrahlen **77:** 14–28, July 1952. (In German)

The authors made postmortem angiograms of the lungs in 86 cases of tuberculosis, silicosis, and bronchogenic carcinoma. The roentgen changes were found to conform closely with the pathologic-anatomic changes described at autopsy. Injected blood vessels were demonstrated down to a size of about 1 mm. in diameter. In inflamed sections of the lungs some hyperemia was present. In other words, small blood vessels that otherwise would not be visualized reached the size of 1 mm. or more in diameter and became demonstrable. There was, therefore, an apparent increase in the number of blood vessels. Caseous tuberculosis, on the other hand, produces an obliteration of the smaller blood vessels, with an apparent decrease in the number of vessels. Sometimes only the larger "naked" vessels without any ramifications are demonstrated. These changes are particularly obvious in caseous pneumonia producing the typical picture of a naked vascular tree. Similar findings are observed in the presence of a fresh cavity. In older cavities, however, a wall of granulation tissue has been built around the wall of the cavity containing numerous small vessels; older cavities may also produce a distortion of the vascular stumps due to scarring.

Silicosis with small nodules may not show any changes in the angiogram whatsoever because vessels 1 mm. in diameter or larger have not been involved. If the disease, however, has progressed to medium or large-size nodules, vessel stumps with areas of vascular destruction can be seen. Chronic emphysema produces similar changes, and the differential diagnosis cannot be established angiographically. In tuberculosis, as well as in silicosis, one or both of the pulmonary arteries may be markedly stenosed by groups of lymph nodes with scar formation. If such stenotic areas are located at the site of the hilar vessels, they may markedly strain the right ventricle of the heart; operative freeing of the stenosed vessels may be considered. If scars have formed between the lungs and the parietal pleura, or perhaps between the lungs and the aorta, vascular bridges between the lesser and the greater circulation are sometimes observed.

The angiographic findings in bronchogenic carcinoma are very similar to those in tuberculosis. The arteries may be compressed and displaced. Cancer growing into the vessels may diminish the lumen of the larger vessels or the vessels may be kinked by metastatic nodes.

Since the appearance of the vascular tree is similar in pulmonary tuberculosis, silicosis, and bronchial carcinoma, differential diagnosis is impossible from the angiogram. The same vascular changes occur in other pulmonary conditions, such as emboli, pneumonia, lung abscess, bronchiectasis, emboli, etc. Therefore, angiography of the lesser circulation is of no value as a differential diagnostic procedure.

Eleven roentgenograms.

WM. A. MARSHALL, M.D.
Chicago, Ill.

Tracheographic Diagnosis of Cancer of the Upper Air Passage. A. Tänzer and A. Beutel. Radiol. clin. **21:** 1–10, January 1952. (In German)

During the past twenty years there has been a startling increase in the number of cases of bronchogenic cancers reported, but primary carcinoma of the trachea is still rarely seen. After reviewing previously reported cases, the authors present 2 cases of their own. In 1945, Ellman and Whittaker (Thorax **2:** 153, 1947) were able to collect from the literature 507 primary tumors of the trachea, 187 of which were carcinomas.

As early as 1915 Fraenkel (Deutches Arch. f. klin. Med. **135:** 184, 1921) demonstrated the value of the roentgen examination in showing a narrowing of the tracheal lumen. Later the use of contrast media and body section roentgenography further facilitated the differential diagnosis of tumors in the air passage. Fraenkel saw 10 cases of tracheal cancer, in which the tumors were of two types: (1) an oval or round mass, well circumscribed, extending into the lumen and (2) a diffuse infiltration with smooth or irregular borders, involving the wall, extending into the paratracheal, paraesophageal, and mediastinal regions. These masses have a tendency to ulcerate and, therefore, bloody sputum is a predominant complaint. The upper third is the most common site of a tracheal cancer, but occasionally the lower third is involved. The tumors seldom break through into the esophagus or thyroid but metastasize relatively early. The regional lymph nodes are involved first; they can become very large, often being diagnosed as mediastinal tumors. They may also produce compression on the bronchi, nerves, blood vessels or even on the trachea. Metastasis to the lungs, liver, spleen, pancreas, kidney, and skeleton also occurs. In a number of cases metastases to the skin were observed, which led Keeney to remark that when tracheobronchial stenosis with cutaneous metastases is seen the primary tumor is more likely to be in the trachea than in the bronchi. Histologically the tumors are squamous-cell or adenocarcinomas, the latter being the most common.

The authors' first case was that of a 46-year-old man who complained of pain in the right lung and neck accompanied by cough. X-ray examination showed a density of the right upper lobe which was thought to be inflammatory in origin, and the patient was treated accordingly. Two months later the pain became more intense, and the patient returned to the hospital. Bronchographic examination disclosed an oval mass, the size of a hazel-nut, about 2 cm. above the bifurcation. On biopsy the tumor proved to be a squamous-cell carcinoma. One week later a hard mass was palpable in the skin on the right side of the abdomen, and biopsy revealed metastatic carcinoma.

The second patient was a 48-year-old man who had pain in the right side of the chest accompanied by cough. Two months later a cough with bloody expectoration developed, and x-ray examination showed a mass in the right hilar region. A diagnostic pneumothorax was performed. Subsequent bronchoscopy revealed a carcinoma of the tracheal wall, on the right side above the bifurcation. On bronchography a 3 cm. long, slightly irregular thickening of the trachea was visible, with a flat filling defect narrowing the lumen. This mass represented a flat carcinoma above the bifurcation, with occlusion of the right upper lobe bronchus by enlarged lymph nodes.

In the differential diagnosis of the first case the smooth mass in the trachea could have represented either a benign or malignant lesion, but the presence of early metastases in the adjoining lymph nodes was helpful in establishing the diagnosis of malignant

tumor. In the second case the irregular outline of a flat infiltrating tumor suggested the presence of a malignant growth; Haslinger (Monatschr. f. Ohrenh. **63:** 357, 1929) has pointed out, however, that the same narrowing of the trachea is seen in lues and scleroma. The presence of metastases, however, facilitates the diagnosis.

Four roentgenograms. JULIAN O. SALIK, M.D.
Baltimore, Md.

Pulmonary Coccidioidomycosis: Clinical and Roentgenological Observations in Residual Lesions. Mark H. Joress and Boris P. Bushueff. Dis. of Chest **22:** 55–67, July 1952.

Persons showing residuals of the primary infection of pulmonary coccidioidomycosis are now being observed in every part of the United States. The most common residual lesion is the nodular density, consisting of a single, small fibrous infiltration. These nodules may be multiple. Moreover, instead of a well circumscribed nodular density, there may be single or multiple large masses, with little or no visible fibrous reaction around them. When they are large and show no fibrous reaction, they are considered as representing the granuloma of latent coccidioidomycosis, similar to a tuberculoma. Each is equally capable of spontaneous dissemination. A number of writers have stressed the presence of calcium within or adjacent to these nodules, but in their cases the authors observed no calcification within the nodular residuals nor did they note calcium deposition in the tissues adjacent to these or cavitary lesions. An organized effusion may be the end-result of an effusion accompanying the pneumonic form of primary infection. Other, less common, residuals are miliary lung infiltration, chronic pneumonitis, and mediastinal and hilar adenopathy.

Twenty-three patients with residual coccidioidal lesions have been seen by the authors over a four-year period. In 12 cases roentgen examination showed a lesion of the nodular type; in 7 residual cavitation was present. Four patients had no visual residuals.

Reactivation occurred in 4 of the authors' cases. In 3 cases pathological activity developed in the presence of cavitary lesions and in the fourth within a granulomatous lesion associated with an organized pleural effusion.

Ten roentgenograms. HENRY K. TAYLOR, M.D.
New York, N. Y.

Frequency of Laboratory Infections with Histoplasma Capsulatum: Their Clinical and X-Ray Characteristics. Michael L. Furcolow, Warren G. Guntheroth, and Myron J. Willis. J. Lab. & Clin. Med. **40:** 182–187, August 1952.

In any laboratory in which infectious materials are studied and handled, the possibility of infection of personnel must be considered. The authors attempt to assay the hazard associated with the handling of a pathogenic fungus, *Histoplasma capsulatum*, the clinical illness which accompanies such a laboratory infection, and the characteristics of the chest lesions which appear in the roentgenogram.

Of 56 persons employed at the Mycoses Laboratory of the Public Health Service in Kansas City, Kansas, during a period of six and one-half years, 30 were positive to histoplasmin when first tested. In 17 others positive histoplasmin reactions were obtained after periods of employment varying from one month to three years. The conversion rate from a negative to positive skin test for the laboratory employees was 13.23 per 100 susceptible person months, while in a large group of school children the conversion rate was 0.47. The difference between these two rates is considered to be statistically significant.

The conversion in skin test (change from negative to positive) was accompanied by a definite clinical illness in 7 of the 17 laboratory personnel under observation (41 per cent). This illness was non-specific in character, but in one instance caused nine weeks absence from work. Five of the 7 patients with illness accompanying conversion had x-ray changes in the lungs at the same time. One patient had an ill-defined basilar pneumonic lesion in the left lower lobe and a small pneumonic lesion in the right first interspace; these lesions showed contraction during fourteen months of follow-up. The roentgenograms of a second patient showed two small nodular lesions in the right fourth and left fourth interspaces which healed by fibrosis after nineteen months. A third patient had an enlarged, right mediastinal node which regressed after fourteen months observation. In the fourth patient a pneumonic lesion appeared in the right third and fourth interspaces after the clinical illness had subsided, and persisted for at least four months. The fifth patient showed a pneumonic lesion in the right fourth interspace which cleared in several weeks and a pneumonic lesion with enlarged hilar lymph nodes on the left which persisted for at least six weeks. The roentgenograms of 2 other persons revealed lesions without accompanying illness: one a pneumonic lesion in the left fourth interspace and the other a pneumonic lesion in the third interspace. The average x-ray follow-up for the group was 20.1 months, but 5 of the "converters" were followed for less than six months.

Three tables.

Physico-Chemical Pneumonitis. Sydney Jacobs. Dis. of Chest **22:** 25–32, July 1952.

Physical and chemical agents usually cause a type of pulmonary inflammation which should be called "pneumonitis" and not "pneumonia." Pneumonia is a self-limited inflammation which tends to heal without significant pulmonary damage. Pneumonitis is a chronic, recurrent inflammation with profound interstitial and intrabronchial involvement as well as intra-alveolar exudate, often resulting in suppuration and fibrosis. Organization and fibrosis are the end-results, with permanent pulmonary damage. Basically, a physico-chemical pneumonitis represents a "non-specific" response to a variety of agents. It is impossible to distinguish between these syndromes roentgenographically, and a thorough clinical investigation is necessary to establish the diagnosis.

The etiological factors are many, and usually act through aspiration, inhalation, irradiation, and trauma. The author cites examples of pneumonitis resulting from the aspiration of vomitus during anesthesia and of water from a swamp, salt water, oil, milk fat, kerosene, and gasoline. Inhalation of an irritating gas causes immediate inflammation of the respiratory tract varying from superficial erythema of the mucosa of the upper air passages to a fatal pulmonary edema. Hot irritating fumes from fire may produce clinical manifestations ranging from laryngeal tracheal bronchitis to varying degrees of severe pneumonia (Cocoanut Grove disaster

in Boston). Beryllium fumes may cause an acute pneumonitis or a granulomatosis, marked by dyspnea and cough and associated with extensive emphysema and fibrosis. A chronic pneumonitis may follow irradiation of the thorax, especially for neoplasms of the esophagus or breast. Injury to the lung, particularly "blast injury," has been encountered in persons who did not sustain fractures or penetrating chest wounds; the mechanism of injury predisposes to pulmonary edema and hemorrhagic necrosis, with subsequent pulmonary fibrosis.

Five roentgenograms. HENRY K. TAYLOR, M.D.
New York, N. Y.

The Normal Cardiac Apex and Apex Beat: A Critical Review of Recent Data. Ronan O'Rahilly. Am. Heart J. **44**: 23–34, July 1952.

There is a lack of agreement concerning the clinical localization of the apex beat. It has recently been defined as the farthest inferolateral point of maximal pulsation. Only a certain proportion of apex beats can be localized by palpation, from 24 to 98 per cent according to various writers. The mean distance of the adult apex beat from the midsternum is 3.25 to 3.5 inches in the recumbent posture, 3 inches with the subject erect. The existence of a direct relationship between the width of the thorax and the position of the apex beat is disputed. The apex beat is commonly in the fifth, or perhaps in the fourth or fifth, intercostal space. It is rarely in the third or sixth intercostal space.

The apex of the heart is formed by either the left ventricle or the ventricular septum, rarely by the right ventricle. Radiologically, the apex is influenced by the orientation of the heart and body, and the cardiac contour is frequently such that no apex is definable. This is in agreement with the observation that 16 per cent of normal hearts have been found to show no anatomic apex postmortem. It appears that the apex beat is usually above the apex, while it is most frequently lateral and sometimes medial to the apex or to the left cardiac margin. An acceptable definition of the radiologic apex does not seem to be available, and it is questionable whether the term "apex" has any value as a localized landmark in many cases.

Three illustrations.

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San Francisco, Calif.

The Angle of Clearance of the Left Ventricle. Abe Ravin and Charles M. Nice. Ann. Int. Med. **36**: 1413–1422, June 1952.

If a patient is slowly rotated into the left anterior oblique position during fluoroscopy, the left ventricle overlying the shadow of the vertebrae gradually separates from the vertebral column. The angle through which an upright subject must be rotated in the left anterior oblique position in order to separate the left lower cardiac border (left ventricle) from the vertebral column is the angle of clearance of the left ventricle.

The method for determination of the angle of clearance involves the use of orthodiascopy. The only other apparatus needed is a steel bar, measuring $15 \times 1 \times 0.2$ cm. and with tapered ends. Two small holes are made approximately 7 cm. apart, through which a piece of string is laced, and the bar is suspended necklace-fashion around the patient's neck, resting on the chest.

To determine the angle of clearance, the subject with the measuring bar in position stands behind the fluoroscopic screen, with his arms placed over his head. The forearms must be crossed over the head to get the elbows in, so that the patient may be rotated without the elbows striking the screen. He is then rotated into the left anterior oblique position until the shadows of the anterior margins of the vertebral bodies are just barely separated from the heart in diastole during quiet respiration. A central ray is used to determine this position. The ends of the shadow projected by the steel bar are marked. The apparent length of the bar in the left oblique position, divided by the actual length of the bar (15 cm.), is the cosine of the angle of clearance. From a table, furnished by the authors, the apparent length of the bar is read directly into the angle of clearance.

The advantages of the metal bar hung in front over other markers are the ease of application and its greater visibility.

At the time the angle of clearance is determined, orthodiagraphic tracings in the anteroposterior position are made directly on the screen with a wax pencil and later are copied onto onion-skin paper. The entire procedure takes less than three minutes.

Factors Influencing Results: (1) The making of orthodiagrams requires a certain amount of experience for proficiency; (2) The point at which the heart clears the spine in adults can usually be determined accurately but the eyes must be well dark-adapted; (3) The phase of heart action and respiration chosen for the end-point must be uniform; (4) Deformities of the spine (especially lordosis and scoliosis) make determinations of the angle of clearance worthless; (5) In determination of the angle by means of the turntable, the big factor of error is the rotation of the trunk; (6) Variations in results obtained by this method in the same person at different times are attibutable mainly to variations in the end-point of rotation.

The angle of clearance was determined on 200 men, mainly medical students. In this group the following data were collected: height, weight (with shoes and pants on), external anteroposterior diameter of the chest, external transverse diameter of the chest, transverse diameter of the heart and internal chest diameter from the orthodiagram, heart diameter in the left oblique position, and angle of clearance.

The angles of clearance ran from 38 to 86. The symmetry of the curve was quite marked. The median and mode were 63. The exact average was 62.7, with a standard deviation of 9.2. When the angle of clearance was charted against the transverse heart diameter, those cases that fell farthest out of line showed external anteroposterior chest diameters either in the low or high categories. The coefficient of correlation for the angle of clearance with both the transverse heart diameter and the anteroposterior chest diameter was 0.51.

In this group of normal adults, the wide scatter obtained made it evident there was no "normal angle" above which one might consider the angle abnormal. The correlation between the angle of clearance and the other data which had been collected was disappointing. Preliminary work indicates that it may be possible to predict the angle of clearance with some accuracy on the basis of height, weight and external anteroposterior chest diameter.

Early work on patients with cardiac enlargement indicates that the angle of clearance increases quickly with cardiac enlargement, and that it may increase more markedly with left than with right ventricular enlargement. The angle of clearance at the present time can only be of value in following the changes which might occur in the same patient.

In 100 normal women the angle of clearance did not show the smooth curve seen in men. The reason for this has not been determined.

Two roentgenograms; 1 photograph; 3 diagrams; 1 table.

STEPHEN N. TAGER, M.D.
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Congenital Absence of the Right Pulmonary Artery. Diagnosis by Angiocardiography, with Cardiorespiratory Studies. Irving M. Madoff, Edward A. Gaensler, and John W. Strieder. New England J. Med. **247:** 149–157, July 31, 1952.

Congenital absence of a main branch of the pulmonary artery in the presence of aerated lungs has been reported in only 9 cases since 1868. An additional case is presented, the first one in which the diagnosis was established during life.

Diagnosis of absence of the right branch of the pulmonary artery was made by angiocardiography in a 14-year-old girl who was entirely well. Two years earlier the girl had had intermittent contact with an uncle with pulmonary tuberculosis. Since then she had been followed with repeated chest roentgenograms. An upper mediastinal shadow, which failed to change with passage of time, was observed and she was referred for further study. Physical examination and the usual laboratory studies were negative. The chest roentgenogram showed some deviation of the trachea to the right, and the right hemithorax was slightly smaller than the left. Angiocardiography demonstrated a very slight delay in the venous return to the heart, non-filling of the right branch of the pulmonary artery, and slight filling of the right pulmonary arterial tree after aortic opacification, indicating a blood supply from the greater circulation to the right lung.

Bronchoscopy and bronchography revealed slight narrowing of the right-upper-lobe bronchus.

Pulmonary-function studies showed the maximum breathing and vital capacities, residual volume and total lung capacity to be slightly reduced. The minute ventilation was increased both at rest and during exercise. During bronchospirometry with room air, the right lung showed normal ventilation but did not participate in oxygen uptake. As the result of induced hypoxia and by supplying room air to the left lung and oxygen to the right lung, the right lung became responsible for 18 per cent of the total oxygen uptake.

It was estimated that 17 per cent instead of the usual 1 per cent of the cardiac output of the left side of the heart entered the right lung.

Seven roentgenograms; 3 tables.

HOWARD L. STEINBACH, M.D.
University of California

Cor Biloculare. Maurice Campbell, Frances Gardner, and Geoffrey Reynolds. Brit. Heart J. **14:** 317–324, July 1952.

True cor biloculare—a single ventricle associated with a single atrium—is one of the most primitive forms of cardiac defect. There is a common A-V orifice and valve, sometimes with four primitive cusps; there are often other defects as well. Brown (Congenital Heart Disease. London, Staples Press, 1950) states that most of the reported cases of bilocular heart are partial examples, often with other abnormalities. He divides them into (1) complete forms with an undivided truncus arteriosus, (2) complete forms with the aorta and pulmonary trunk divided, and (3) incomplete forms where there is some septal formation but a persistent common A-V valve. The authors present an example of his Type 2. In this case both plain roentgenograms and angiocardiograms were made before death. The clinical diagnosis was pulmonary atresia with a large ventricular septal defect. Pulmonary arteries were thought to be present beyond the atresia but it was not certain how they were supplied. A Blalock-Taussig operation was done, but the child died suddenly the following day.

In addition to the cor biloculare, necropsy showed an atretic pulmonary trunk, with right and left pulmonary arteries supplied by a patent ductus arteriosus on the left; an aorta arising from common ventricle without a rudimentary chamber; absence of the inferior vena cava; large azygos vein draining lower part of the body, persistent bilateral superior venae cavae; and transposition of the abdominal viscera but not of the heart.

Although a correct diagnosis of some of the anatomical abnormalities was made preoperatively, cor biloculare was not thought of. The authors believe a single ventricle might have been suspected because of the absence of any sharp border of the right ventricle in the angiocardiograms and the way in which the contrast medium passed across to the left. The left to right shunt at this site shown on cardiac catheterization did not help greatly as this is fairly common with Fallot's tetralogy.

Five roentgenograms; 3 photographs; 1 electrocardiogram; 2 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Patent Ductus Arteriosus in the Absence of a Continuous Murmur. J. Francis Dammann, Jr., and C. Gordon R. Sell. Circulation **6:** 110–124, July 1952.

Although the absence of a continuous murmur in the pulmonary area casts doubt upon the diagnosis, a large patent ductus may exist without a typical murmur. A continuous murmur is seldom heard in infancy. It may also be absent in patients who have pulmonary hypertension or who are in heart failure. A large patent ductus can cause acute cardiac embarrassment and may possibly lead to irreversible pulmonary vascular changes. Its diagnosis in the absence of the characteristic murmur is therefore important.

The authors present their findings in 24 patients in whom the clinical diagnosis of patent ductus was considered despite the absence of a typical murmur. The findings usually were failure to grow and develop normally, repeated episodes of pneumonia, dyspnea, early onset of cardiac failure, usually a high pulse pressure and a bounding pulse, splitting and accentuation of the second heart sound at the base, a systolic murmur along the left sternal border and commonly an apical rumbling mid-diastolic murmur.

Fluoroscopy and roentgenograms in each instance revealed increased pulmonary vascularity but not always increased hilar pulsations. The main pulmonary

artery segments were convex. Generalized cardiac enlargement was the rule; there was definite left auricular enlargement in 13 patients with patent ductus, 6 with ventricular defect and 2 with an aortic septal defect. Retrograde aortography recently has proved most helpful in differential diagnosis.

The electrocardiographic findings were in no way uniform.

Cardiac catheterization was performed in 17 patients. Every patient had marked right ventricular or pulmonary arterial hypertension. In 10 of the 11 patients with a patent ductus who were catheterized, there was a significant rise of oxygen content on passing from the right ventricle to the pulmonary artery.

All of the 24 patients suspected of having a patent ductus without a continuous murmur were operated upon. In 15 a large patent ductus was found; the 13 patients who survived surgery were greatly helped. Seven patients had high ventricular septal defects and 2 had aortic septal defects. There were 4 fatalities. The high mortality rate emphasizes the risks of exploratory thoracotomy and the need for more accurate diagnosis.

Three roentgenograms; 1 drawing; 3 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Infundibulum of Patent Ductus Arteriosus—A Diagnostic Sign in Conventional Roentgenograms. Gunnar Jönsson and Georg-Fredrik Saltzman. Acta radiol. **38**: 8–16, July 1952.

Enlargement of the heart, dilatation of the pulmonary artery, and the pathologic pulsations in the central branches of the pulmonary artery (hilar dance) are characteristic roentgenologic features of patent ductus arteriosus. These signs are common in patent ductus, but they are neither constant nor specific. The commonest of them, dilatation of the pulmonary artery, is demonstrable in 50 to 70 per cent of all cases. The only pathognomonic lesion visible on conventional roentgenograms, as yet described, is the rarely observed calcium deposit in the ductus.

In thoracic aortograms the infundibulum of the ductus is usually best seen in the lateral views, but in most of the authors' cases this structure was also visible in anteroposterior projections. The authors therefore concentrated their studies on the appearance of the aorta on conventional postero-anterior views. A deformity of outline of the aorta was found in the situation where the aortic arch becomes continuous with the descending aorta. Of 39 cases of patent ductus arterosus, 21 showed definite deformation of the aortic shadow at the site of the infundibulum of the ductus. In the majority of cases the concavity normally present on the left side of the aorta was lacking. It was replaced by a slight convexity which gradually became continuous with the straight outline of the descending aorta, creating the impression that the point of transition between the aortic arch and the descending aorta was displaced downward. The deformity of aortic outline was visible in conventional postero-anterior roentgenograms in 21 of 39 cases of proved patent ductus arteriosus. A deformity was suspected in 5 of the remaining cases.

In the 13 cases in which the deformity was not demonstrable, failure of visualization was attributed to a greatly distended pulmonary artery almost entirely concealing the uppermost part of the aorta and thoracic cage deformities; it is also impossible to see such a deformity when the ductus arises from the middle of the aortic arch.

The aortic irregularity described was not observed in a comparative study of normal individuals.

Five roentgenograms; 2 drawings.

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Double Aortic Arch Treated Surgically. A. L. d'Abreu, Roy Astley, and Alan Parkes. Brit. J. Surg. **40**: 70–73, July 1952.

A case of double aortic arch is reported, with discussion of symptoms, embryology, surgical technic, and radiological appearance, including differential diagnosis.

The symptoms are due to tracheal or esophageal compression and include stridor, dysphagia, head retraction, frequent pulmonary infections, and cough. In the authors' case the patient could be fed only when lying on the abdomen; feeding in the usual position resulted in severe cyanosis proceeding to almost unconsciousness.

The important preoperative radiological features are the constant appearance of tracheal narrowing opposite the third dorsal vertebra, absence of tracheal and esophageal displacement, compression of the esophagus by indentations on all sides, and the appearance and disappearance of areas of atelectasis in the lung.

The conditions requiring differential radiological diagnosis are: (1) a vascular ring produced by a posterior right aortic arch and the ligamentum arteriosum; (2) an anomalous subclavian artery. The vascular ring appears to be more difficult to differentiate. As Neuhauser has pointed out, in that condition the posterior impression on the esophagus would be of a size that would be associated with an aorta of the usual diameter, while in the double arch the posterior defect is rarely more than half the expected size. The appearances produced by an anomalous right subclavian artery are more obviously different. The vessel passes upward from left to right on a level higher than the aortic arch, usually behind the esophagus. It produces a single notched defect, on the left posterolateral aspect (or on the anterior aspect on the rare occasion when the artery runs in front of the esophagus). It does not produce impression on both lateral borders of the esophagus, nor does it compress the trachea.

Three roentgenograms.

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Diagnosis of Tight Mitral Stenosis. Abe Ravin, Balfour Slonim, Oscar J. Balchum, Sidney H. Dressler, and John B. Grow. J.A.M.A. **149**: 1079–1084, July 1952.

Mitral commissurotomy in patients with tight mitral stenosis is beneficial and can be performed with a comparatively low mortality in selected cases. The purpose of the present paper is to describe the factors that are important in the diagnosis of tight mitral stenosis. Seventeen patients with this diagnosis were carefully studied clinically and by means of cardiac catheterization, and the presence of a tight mitral stenosis was subsequently established at operation.

The diagnosis of tight mitral stenosis can be made in many cases on the basis of auscultation alone. Typi-

cally the characteristic diastolic murmur is loud, but occasionally it may be faint, and rarely it may be absent. The position of the heart and the presence of pulmonary emphysema may at times account for a faint murmur. Probably more important is the drop in pressure in the left auricle and the slowing of the blood flow associated with pronounced degrees of right heart failure. In the patients in the authors' series the stenosis was so marked that there could not have been much insufficiency, and in no instance was there a loud systolic murmur.

Next in importance to the auscultatory findings in the diagnosis of tight mitral stenosis is roentgenologic evidence of left auricular enlargement and the absence of left ventricular enlargement. Left auricular enlargement was marked in almost every case seen by the authors and was well demonstrated in both the postero-anterior view and in the left lateral esophagram. The left ventricle was considered to be enlarged in 9 cases and possibly enlarged in 8 cases. The pulmonary artery and its major branches were considered to be enlarged in almost every instance. Enlargement of the right ventricle was thought to be present in the majority of instances but was much more difficult to assess. The lung fields showed increased vascularity in all but 2 cases, with prominence of the vascular pattern, nodular densities, and, in several instances, multiple small calcifications.

An electrocardiogram was taken in 16 cases. In 7 cases it showed auricular fibrillation; there was one instance of persistent auricular flutter. P-wave changes occurred in all the remaining 8 patients, with regular rhythm. The electrocardiogram is of limited value in the detection of right ventricular hypertrophy until it is severe.

Other signs of tight stenosis are diminished cardiac reserve, attacks of paroxysmal auricular fibrillation or tachycardia, episodes of pulmonary edema and congestive heart failure, and hemoptysis occurring with only moderate cardiac enlargement.

Cardiac catheterization, amyl nitrite, and the Valsalva test were of little value in determining the degree of mitral stenosis.

Two tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Pulmonary Arteries in Mitral Stenosis Demonstrated by Angiocardiography. J. F. Goodwin, R. E. Steiner, and K. G. Lowe. J. Fac. Radiologists **4**: 21–27, July 1952.

The authors describe in considerable detail the method of angiocardiography employed in 12 patients with mitral stenosis. Particular attention was paid to the circulation time between the great veins and the left auricle. The patients were graded clinically according to the criteria of the New York Heart Association, 3 being in Group I (no dyspnea), 2 in Group II (dyspnea on moderate exertion), and 7 in Group III (dyspnea on severe exertion).

The 3 patients in functional Group I showed no abnormality in the peripheral pulmonary arteries. The remaining 9 patients (8 of whom had some evidence of pulmonary hypertension), who were in functional Groups II and III, showed varying degrees of occlusive changes in the smaller pulmonary arteries while the main pulmonary arteries were enlarged and the pulmonary circulation was prolonged. The changes were roughly proportional to the degree of clinical severity. Their possible relationship to pulmonary hypertension is discussed.

Nine roentgenograms; 1 table.

A. W. BROWN, M.D.
Charity Hospital, Shreveport, La.

Unusual Cyanosis in a Boy with Congenital Pulmonary Stenosis and Tricuspid Insufficiency. Fatal Outcome After Angiocardiography. Gunnar Biörck, Oliver Axén, and Åke Thorson. Am. Heart J. **44**: 143–148, July 1952.

A case of congenital pulmonary stenosis with tricuspid insufficiency and a peculiar type of cyanosis in a 19-year-old boy is described. Absence of clubbing indicated that the cyanosis was of recent onset. It was more marked on the trunk and face than on the hands and feet, which is unusual. The authors believe that the cyanosis was due to the greatly dilated capillaries and post-capillary vessels and to the slow passage of blood through these because of the elevated right auricular pressure.

On roentgen examination, the heart was found to be enlarged to the left but not to the right, possibly because of a right ventricular hypertrophy. The pulmonary conus was replaced by a concavity. The angiocardiogram showed a great dilatation of the right atrium and right ventricle. These two chambers filled slowly with the contrast medium to an equal extent, and there was retrograde filling of the superior vena cava. At the site of the pulmonary valves was a circular narrowing occupying about 1 cm. of the vessel. The pulmonary arteries were of normal size.

At autopsy the heart was found to be enlarged, the right ventricle exceeding the left in size. The pulmonary artery showed a moderate stenosis. The tricuspid orifice was very wide and the valves were thickened. The right atrium was markedly enlarged, with hypertrophy of the musculature.

An interesting finding was the presence of a tumor in the jejunum and multiple yellow metastases in the liver. The tumor was found to be a malignant carcinoid.

The patient died approximately ten minutes following the angiocardiographic examination. The immediate cause of death could not be established. Previous tests had revealed no evidence of hypersensitivity to the contrast medium (Umbradil).

One illustration.

HOWARD L. STEINBACH, M.D.
San Francisco, Calif.

Tricuspid Atresia: A New Radioscopic Sign. P. J. D. Snow. Brit. Heart J. **14**: 387–390, July 1952.

The authors call attention to a sign recently observed during fluoroscopy in 2 cases of tricuspid atresia. The sign consists of the asynchronous pulsation of the anterior and posterior cardiac border when viewed in the left anterior oblique position. In the normal heart, contraction is synchronous, the posterior border being formed by left ventricle and the anterior border by right ventricle, though occasionally, particularly if an insufficient degree of rotation is employed, the upper part of the anterior border may be formed by the right auricle. When screening a child with cyanotic heart disease it was observed that in the left anterior oblique position, the posterior cardiac border contracted appreciably after the anterior. At the time it was thought that this might have been due to either (1) left

bundle branch block, or (2) replacement of the right ventricle as the main component of the anterior border by the right auricle, as would occur in tricuspid atresia when the right ventricle is non-functioning and hypoplastic. Since left bundle branch block had already been excluded by a full cardiogram, the latter was accepted as the more likely. The diagnosis of tricuspid atresia was subsequently proved by angiocardiography.

The only other condition which theoretically might produce the same phenomenon is bundle branch block. Numerous cases of both left and right bundle branch block have been examined and no asynchrony of ventricular contraction has been detected. Nor has this phenomenon been found in any other condition with the exception of one case in which the diagnosis of tricuspid atresia was possible but not proved.

Six roentgenograms; 3 electrocardiograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Atrial Border Electrokymogram in Mitral Regurgitation. Louis A. Soloff, Jacob Zatuchni, and Herbert M. Stauffer. Circulation **6**: 96–102, July 1952.

An extensive study was made of 15 individuals with normal hearts and 13 with various types of heart disease in an effort to determine the constancy and the specificity of the atrial border electrokymogram in those with organic regurgitation and in those without it.

In 12 of 13 patients with an apical systolic murmur, a typical "plateau" curve, reported by others to be characteristic of left atrial border motion in organic mitral regurgitation, was obtained in either or both oblique views and occasionally in the postero-anterior view over the left third segment or over the right border of the heart.

Identical "plateau" curves were obtained from the atrial borders of 10 persons with normal hearts, including 7 normal male medical students and 3 hospitalized individuals with no apical systolic murmur.

Curves said to be characteristic of atrial border motion in persons with normal hearts were also recorded at various positions in each of the 28 subjects studied.

A "plateau" curve was more frequently obtained in persons with organic mitral regurgitation.

Some explanations for these results are discussed, with the sensible conclusion that more study of electrokymograms is necessary before clear-cut normal or pathognomonic patterns can be pointed out for atrial curves.

Four electrokymograms; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE DIGESTIVE SYSTEM

Esophageal Hiatus Hernia: An Obscure Cause of Massive Hemorrhage from the Upper Gastrointestinal Tract. Lucien W. Ide and John R. McDaniel. Am. J. Digest. Dis. **19**: 151–153, May 1952.

Hemorrhage from the upper gastrointestinal tract is not commonly atrributed to esophageal hiatal hernia in spite of the fact that the literature clearly indicates that the association is not rare. The hemorrhage in this area may be due to a gastric ulcer or an erosion in the thoracic pouch, an associated esophagitis, or congestion resulting from constriction of the pouch.

An esophageal hiatus hernia may be very difficult to demonstrate roentgenologically even when its presence is strongly suspected. The authors present a case to illustrate this point. Their patient, a 44-year-old housewife, was first seen in June 1949, complaining of epigastric pain radiating to the back, between and under the shoulder blades. The pain was sometimes relieved by milk and soda. The patient had never vomited but she had passed several tarry stools. X-ray examination of the stomach revealed no abnormality. Cholecystography was performed twice, and on both occasions no contrast medium was seen in the gallbladder. An exploratory laparotomy and cholecystectomy were performed. The gallbladder was normal except for moderate thickening of the walls.

On June 30, 1950, the patient was seen again, with pain similar to that previously experienced. X-ray examination of the stomach was again normal. On July 8, the patient had a severe attack of epigastric distress and passed a black stool. The red blood cell count at that time was 1,620,000, and the hemoglobin 5.2 gm. On July 17, the stomach was examined again, with special attention to the possibility of a hiatal hernia, but none was found. The examination was repeated three days later. On this occasion the barium was swallowed in the Trendelenburg position, and an esophageal hiatal hernia was demonstrated for the first time.

Repair of the hernia brought complete relief of the patient's symptoms.

Three roentgenograms. JOSEPH T. DANZER, M.D.
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Gastric Diverticula. Report of Thirty-one Cases. Richard W. Eells and Wayne A. Simril. Am. J. Roentgenol. **68**: 8–14, July 1952.

The characteristics of diverticula of the stomach are reviewed with emphasis on the roentgen diagnosis. The principal features of 31 new cases of this lesion and a case report of a diverticulum of the greater curvature are presented.

Pathologically, diverticula of the stomach consists of pockets protruding from the lumen and including all layers of the gastric wall (true diverticula) or mucosal sacs alone herniated through the muscular layer (false diverticula). A congenital origin is suggested by the demonstration of these defects in embryos, the occasional finding of aberrant pancreatic tissue inclusions, and the frequent localized weakening or absence of stomach muscle in the commonest site—the posterior cardia. In some patients acquired pulsion or traction influences are evident. Extrinsic factors, particularly perigastric adhesions from inflammatory processes in the gallbladder, pancreas, spleen, and regional lymph nodes, can at times be demonstrated. From a roentgenologic point of view, these underlying causes cannot often be distinguished, and a practical classification of two main groups may be employed: (1) diverticulum occurring in the juxtacardiac position, probably related to congenital weakness, and seldom giving rise to complications; (2) diverticulum occurring elsewhere in the stomach, usually associated with other disease. The great majority of reported cases falls in the first group.

The authors' 31 cases were drawn from a twenty-five year period during which some 30,000 examinations were performed; this represents an incidence of approximately 0.10 per cent in an unselected group of patients seen on the various services of a university medical center. The essential diagnostic features pertaining to

diverticula and other conditions of the upper gastrointestinal tract with which it may be confused are discussed in some detail.

Five roentgenograms; 2 tables.

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About the Early Stages of Carcinoma of the Stomach. Edwin Grogg. Radiol. clin. **21:** 10–19, January 1952. (In German)

Although early diagnosis of any carcinoma is important, the early recognition of cancer of the stomach is especially important, since resection may promise a complete cure. Attempts have been made to establish clinical and radiological criteria for its diagnosis, as it is assumed that the early removal of a localized superficial neoplasm of the stomach would lower the incidence of metastases. Unfortunately, this does not seem to hold true as a case reported by the author would indicate.

The patient, a 58-year-old woman, consulted a physician because of intestinal symptoms. Two years later x-ray examination showed a deformity of the prepyloric area of the stomach, with infiltration of the wall; occult blood was present in the stools. At gastrectomy a 9 × 3 mm. mucosal defect was found in the prepyloric area, with thickening of the wall. The histologic diagnosis was gastric ulcer, surrounded by chronic inflammatory tissue. The muscle coat of the stomach was not interrupted. Cells in the adjoining area showed an increase of basophilia; some cells revealed atypical mitosis. The submucosa was not invaded by the epithelial cells. The patient felt well for the next six years. Three weeks before death she lost her appetite and discovered that she had lost weight. She had pain in the upper abdomen, in the back, and she vomited frequently. Five days before death she became jaundiced. The clinical diagnosis was tumor of the liver, possibly primary. Autopsy disclosed a liver, weighing 4,200 gm., with yellow masses, the size of small oranges. The histologic diagnosis was multiple diffuse metastases of the liver from a carcinoma.

The author discusses in detail the anatomopathological and histological findings in this case, the literature dealing with the problems of ulcerating carcinomas of the stomach giving an appearance of benign ulcers with malignant degeneration at the edges (Konjetzny, Hartmann, Renaud, Ewing, Newcomb, Willis, Mallory). He also cites 2 similar cases reported by Gutmann and Bertrand, who stated that the occurrence of metastases in early carcinoma of the stomach, which could be considered as carcinoma *in situ*, was rather disconcerting and that possibly very extensive resection of the stomach is indicated in these cases.

Two roentgenograms; 5 photomicrographs.

JULIAN O. SALIK, M.D.
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Observations on Spasms and Peristalsis of the Stomach. A. Mahlo. Forstschr. a. d. Geb. d. Röntgenstrahlen **77:** 44–46, July 1952. (In German)

The tonus and the peristalsis of the stomach are, to a great extent, dependent upon the autonomic nervous system. Both are subject to wide variations during x-ray examination. Such variations may be caused by the dislike of drinking the barium, excitement, etc. The change in the reaction of the autonomous nervous system can be measured objectively by the action currents. The author measures the action currents by placing one fine flexible wire through the mouth of the patient into the stomach down to the pylorus. The other electrode is placed upon the anterior chest wall. The observations are made with the patient in a horizontal position, *i.e.*, lying down. The manner in which the stomach fills is dependent upon the tonus, and the latter in turn depends to some extent upon the potential of the action currents and upon the frequency of their cycles. These, again, are dependent upon the mode of reaction of the autonomic nervous system. Peristalsis is not entirely dependent upon the tonus. In complete atony, however, there are no action currents and there is no peristalsis. The peristalsis will begin only if the action current begins. The latter can be stimulated by the intravenous injection of acetylcholine, a parasympathomimetic agent, which acts upon the vagus. The peristalsis is, in the various patients, characterized by differences in the wave lengths, in the height of the amplitude, in the speed, in the frequency, and in the length of the refractory phase.

With the soft wire in place within the stomach, an interesting observation has been made. In most patients, during the peristaltic waves, the barium fills the entire transverse section of the stomach. In other patients, particularly those with an ulcer along the lesser curvature, it has been observed that during a spastic contraction the barium shows a narrow, hourglass-like appearance in the region of the ulcer. However, this is not produced by an hourglass-like contraction of the entire stomach, because the thin wire can be seen some distance away, lateral to the barium. The picture is apparently produced by an autoplastic function of the mucous membrane near the ulcer while lateral to it the stomach is empty, the anterior and posterior wall of the stomach being in close contact. The films plainly show the contraction of the barium near the ulcer niche, then laterally, an empty space of about 2 cm., and then the thin wire. Apparently, our conception that in spastic contraction the entire stomach wall contracts should be revised. These observations apply only to the function of the stomach while the patient is in recumbent position. In the upright position, gravity produces a tight filling across the entire lumen in the lower portion of the stomach.

The so-called spastic contraction seen in the region of a peptic ulcer of the lesser curvature of the stomach and in which the barium shadow, just like a finger, points to the ulcer itself may not be a spasm at all, for the author has found that it does not disappear after the administration of antispasmodics. The author believes rather that the barium contraction there is more the result of a shrinking process, which pulls the folds of the mucous membrane closer to the ulcer, and is actually an expression of healing. This opinion seems to be confirmed by the observation that the action current of the stomach does not show an increase in the region of the ulcer, such as one might expect in connection with spasm and with increased vagotonus.

Four roentgenograms.

WM. A. MARSHALL, M.D.
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The Roentgenological Appearance of the Gastric Mucosa in Blood Diseases. Marcel Brombart. Am. J. Digest. Dis. **19:** 137–143, May 1952.

Although there are always histologic changes in the gastric mucosa in patients suffering from blood dys-

crasias, the macroscopic changes are not constant. Either atrophy or proliferation may occur. In diseases of the red blood cells, the hypertrophic status is due to edema, inflammatory infiltration, hypertrophy of glands, hypertrophy of the muscular fibers, or several of these factors. In diseases of the white cells, the gastric mucosa may take on hypertrophic appearance as a consequence of mass infiltration of ripe white cells, young or metasplastic forms. The x-ray examination is less satisfactory in the diagnosis of gastritis than it is in the diagnosis of cancer. The mucosal pattern can generally be well visualized if a careful technic is utilized. This consists of spreading a small quantity of barium in a "thin layer" over the mucosa, palpation and careful study of the rugae.

In a proved case of Biermer's anemia x-ray examination showed the folds of the body of the stomach, and particularly those of the "Magenstrasse," to be extremely thin, smooth, and close-set. There was no deformity of the folds; this is apparently due to the capacity of an atrophied muscularis to produce folds.

Hypertrophic gastritis can be detected rather easily by x-ray examination. Thickened rugae of increased depth may also occur, however, in functional or allergic conditions. In the author's cases of giant hypertrophic gastritis, the following radiological characteristics were observed: The gastric folds are enlarged and have a disordered construction. They are hard and tense. The gastric walls are stiff. The lesser curvature shows indentations of different sizes and shapes. Secretions are more abundant than normal. The barium may mix with the increased mucous adhering to the mucosa and produce the "mucous phenomenon" described under the name of "Schummerung." The walls, especially those of the antral area, are inclined to spasmodic contractures called "Krampftumoren."

Two cases are reported of hypertrophic gastritis and a blood dyscrasia occurring in the same patient. In one of the cases the gastritis persisted even after the dyscrasia had disappeared, leading the author to believe that the change in the gastric mucosa is the cause and not the consequence of anemia.

Twelve roentgenograms.

JOSEPH T. DANZER, M.D.
Oil City, Penna.

The Radiology of Infantile Pyloric Stenosis. I. The Radiology of "Atypical" Hypertrophic Stenosis. Roy Astley. Brit. J. Radiol. **25:** 342–350, July 1952. **II. The Indications for X-ray Examination in Infantile Pyloric Stenosis. A Clinical Assessment.** B. S. B. Wood. Ibid., pp. 350–352.

Astley states that the high accuracy of diagnosis by manual palpation of the pyloric tumor in hypertrophic pyloric stenosis in infants leaves only a small proportion of cases (8 per cent in one series) sufficiently atypical to require roentgen examination for diagnosis. The diagnosis is not always clear cut, and a standard technic and diagnostic criteria are advisable.

The baby should be examined three to four hours after a feeding. After routine examination of the chest, the baby is turned on its right side and given a warm suspension of 50 per cent barium sulfate containing no foodstuff. The first swallows are watched down the esophagus, then the baby is turned slightly into the left posterior oblique position, relative to the screen, and the feeding is continued. This rotation causes the barium to pass forward into the pyloric antrum and become available for evacuation. The volume of contrast medium required is less than half a fluid ounce. The position is maintained as long as an hour if necessary. A normal pylorus is usually visualized within five minutes and pyloric stenosis within thirty minutes. Spot films are taken as indicated. No determination of gastric emptying time is made.

Roentgen findings fall into three groups. *Group* I: After a brief inactive phase, perhaps lasting a minute, peristalsis appears and the waves become strong. The proximal portion of the stenosis is now seen as a beak-like projection, especially prominent as each wave approaches the antrum. After some delay the pylorus opens and barium enters the duodenum. The prepyloric portion of the stomach, directed posteriorly in the nearly lateral left posterior oblique projection, is constantly narrowed and devoid of peristalsis. It may show as a "hair-line" of barium, as two or three parallel lines (crowded mucosal folds), or as a canal of width up to 3 mm. It is often slightly curved (concave upward), with a length of 8 to 30 mm. *Group* II: In a few children no gastric evacuation occurs for a considerable time. The longer the time in which good peristaltic waves are ineffective, the more certain the diagnosis becomes. Eventually the stenosis is seen. *Group* III: In this group filling of the stenosis and the duodenal cap may be very fleeting, or gastric emptying may be so free that adequate study of detail is prevented by barium in the jejunum. It is sometimes difficult to be certain of the constancy and aperistalsis of the narrowed segment. If gastric inactivity occurs, peristalsis can often be stimulated by gentle palpation or by giving a little more barium.

Distinction must be made between normal delay, "infantile pylorospasm," gastric inactivity, peptic ulceration, congenital bands, and duodenal obstruction.

Wood discusses the indications for x-ray examination in infantile pyloric stenosis. He believes that an experienced physician can be expected to make a diagnosis of pyloric stenosis by palpation of the tumor in 90 per cent of cases. During the period covered, 85 babies vomiting from other causes were examined, and 2 were thought to have palpable pyloric tumors, a false positive rate of 2.3 per cent. One of these was not examined radiologically; in the other, x-ray studies showed partial duodenal obstruction.

Nine figures, including 14 roentgenograms; 3 tables

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Concerning Flattened Niches of the Stomach. Albert Hudak. Radiol. clin. **21:** 263–268, July 1952. (In French)

Gutmann, in 1936, stated that the niche "en plateau" in the stomach indicated cancer. Later he modified this view, saying that it may be seen in benign ulcer but that it occurs more often in cancer. The author believes that the niche "en plateau" of Gutmann, especially the benign variety, is rarely observed and that it may be due to a benign ulcer or tumor.

Four cases are presented to illustrate certain points. Niches refractory to treatment are not always malignant. In the course of the disease the niche "en plateau" may become curved without becoming carcinomatous. The niche may also change its appearance during an examination. The incidence of the rays at which the roentgenogram is taken and the tonicity of the gastric wall seem to affect the appearance of the

niche. Gastroscopic and histologic studies indicate a connection between niches "en plateau" and atrophic and hemorrhagic gastritis.

Nine roentgenograms. CHARLES M. NICE, M.D.
University of Minnesota

Acute Perforated Gastroduodenal Ulcer. Ivan N. Ingram and John R. Ervin. Am. J. Surg. **84:** 30–41, July 1952.

The authors present a series of 160 cases of perforated peptic ulcer seen at the Southern Pacific General Hospital, San Francisco, from 1927 to July 1951. Of this number 149 were treated surgically, usually by simple closure. The remaining 11 patients were treated by conservative measures.

Gastric ulcers appeared to occur in an older age group and to be associated with a higher mortality rate (10 or 42) than the duodenal perforations (10 of 109). The overall mortality rate was 13.24 per cent; antibiotics have helped to lower the death rate in recent years.

Conservative therapy, with continuous gastric suction, may seem advisable. Wangensteen (Minnesota Med. **18:** 477, 1935) believes that it is safe to treat conservatively patients in whom no evidence of perforation is found on x-ray examination. Although the authors' results were better when no air was demonstrable roentgenologically, they have found the perforation gaping and unsealed at operation. Roentgenograms, however, were taken in very few of the operated cases. Of this number 58 per cent showed pneumoperitoneum, while 42 per cent showed no free air. Fewer complications occurred in the cases in which no air was visible on x-ray examination. The authors recognize the use of both upright and left lateral decubitus films in the demonstration of free air.

Patients who have had perforated peptic ulcer should be followed closely; if symptoms persist or recur, gastric resection should be considered, usually as an elective procedure.

Two roentgenograms; 2 tables.
JOHN F. RIESSER, M.D.
Springfield, Ohio

Gastro-Pleural Fistula: Review of the Literature with a Report of a Case Due to Reticulosarcoma of the Stomach. J. W. Laws. Gastroenterology **21:** 351–356, July 1952.

Gastropleural fistulas are rare; in a review of the literature the author was able to find 26 cases. Eighteen of these developed as complications of perforated gastric ulcer. Five were complications of post-traumatic diaphragmatic hernia; in 2 the hernia was not recognized and the fistula was produced by needling or other surgical interference in an attempt to promote drainage. Two fistulas followed directly from gunshot wounds, and 1 was due to rupture of a hydatid cyst of the lung.

The author's case is that of a man first seen in 1946, with an enlarged right axillary node of six months duration. Biopsy was inconclusive. In 1950, the patient returning, giving a history of ten weeks of coughing of a cupful of mucopurulent sputum a day, dyspnea, and occasional epigastric pain. There were enlarged axillary nodes and a left-sided pleural effusion. Biopsy of a lymph node was reported as showing reticulosarcoma. Bloody fluid was obtained on paracentesis.

One month after the second admission and a second paracentesis, x-ray examination revealed a left-sided tension pneumothorax. Subsequently, a dark green fluid began to drain from the left pleural cavity. The patient died from a terminal bronchopneumonia. Autopsy disclosed a fistula leading from the left pleural cavity, through the diaphragm, and the posterior aspect of the left lobe of the liver into the stomach, near the cardio-esophageal function. Organs about the fistula were involved in a new growth which microscopically appeared to represent a lymphoblastoma with features of Hodgkin's disease.

One roentgenogram; 1 diagram; 2 photomicrographs. JOHN F. RIESSER, M.D.
Springfield, Ohio

Inadvertent Gastro-Ileostomy. Benjamin Sherwin and Abba A. Messe. Gastroenterology **21:** 382–390, July 1952.

Inadvertent anastomosis of the stomach with the ileum has been reported in detail 35 times. A constant feature of published cases is that the original operation was done by some surgeon other than the one reporting the case. The authors suspect that some cases have not been reported in which the surgeon who made the original technical error also performed the corrective operation.

The authors present 4 cases of inadvertent gastroileostomy. In the first 2 there was a long asymptomatic interval between the original operation and the corrective procedure. The first patient came under study as a result of anastomotic ulcers; the second, because of a bout of diarrhea, probably due to an intercurrent infection. Their remarkably good course after gastroileostomy lies in the fact that most of the food went through the duodenum and not through the gastroileostomy stoma. In the second case the gastrointestinal series showed the stomach to empty rapidly, and then refill in three hours. Most of the barium passed through the pylorus and did not appear at the gastroileostomy stoma for three hours. Filling of the stomach during a barium-enema study depends on the competency of the ileocecal valve.

In the third and fourth cases the original procedure was associated with subtotal gastrectomy and not with gastroenterostomy. Here there is no alternate pathway for the food which in these cases emptied directly into the terminal ileum from the stomach. As a result symptoms began shortly after the original procedure. Weight loss, anorexia, nausea, and foul-smelling vomitus were the predominant complaints.

Four roentgenograms. JOHN F. RIESSER, M.D.
Springfield, Ohio

Primary Carcinoma of the Third Part of the Duodenum. K. E. Rogers, J. C. Goligher, and E. Rohan Williams. Brit. J. Surg. **40:** 1–5, July 1952.

Two cases of carcinoma primary in the third part of the duodenum are reported, diagnosed radiologically and removed surgically. Carcinoma of the duodenum is rare, having been shown to occur in only 0.033 per cent of 350,286 autopsies and to constitute only 0.3 per cent of all gastrointestinal carcinoma. However, of all small bowel primary carcinomas, approximately 45.6 per cent occur in the duodenum.

The present authors stress the importance and difficulties of radiological diagnosis and suggest examination during attacks of nausea and vomiting and the use of

supine fluoroscopy and films. They emphasize, also, the feasibility of radical removal with "at any rate good immediate results" (one of their patients died of recurrence four years later, the other is alive and well after one year).

The symptoms in each case were those of high intestinal obstruction, *i.e.*, intermittent nausea and vomiting of bile and altered food, weight loss, and in one case dehydration. No palpable mass was present in either patient. X-ray examination demonstrated stenosing lesions with proximal distention.

The technic of surgical removal is discussed.

Four roentgenograms; 1 photomicrograph, 2 photographs. MARSHALL B. TUCKER, M.D.
Oakland, Calif.

Double Colon. Differentiation of Cases into Two Groups, with Case Report. Benjamin R. Van Zwalenburg. Am. J. Roentgenol. **68:** 22–27, July 1952.

Prior to the present case, only 28 examples of reduplication of the colon or a portion of the colon have been recorded in the literature. In the majority of cases the abnormalities are described as large diverticula or cysts, lying more or less parallel to the bowel within the mesentery between the root of the mesentery and the normal bowel. Only 6 of the previously reported cases had a reduplication of the bladder and urethra in addition to the reduplication of the colon.

The author discusses the probable embryological differences of the two groups. He believes that the abnormalities in the smaller group are the result of early twinning of the hind gut anlage in that all structures derived from the hind gut distal to the most cephalad point of duplication are in duplicate, including the bladder and urethra. Clinically the two groups are different. Patients in the larger group come to attention because of mesenteric masses which have produced obstruction by their size or have caused volvulus, or because of bleeding due to ulceration and even perforation. Cases in the smaller group have been asymptomatic except when errors such as imperforate anus or imperfect formation of the septum between the rectum and the urogenital sinus have been present.

The case of reduplication of the colon seen by the author belongs in the smaller group. The patient's chief complaint was bleeding from the rectum of three weeks duration. Physical examination showed a heavy septum dividing the rectum into two equal compartments. In addition, a longitudinal septum divided the vagina into two openings. There were also two patent urethrae. Roentgen examination revealed two complete colons running parallel to each other, each with its own terminal ileum, with a polyp of the right colon and a diverticulum of the left. The bleeding in this case was due to the polyp and not to the anomaly.

Six roentgenograms. A. W. BROWN, M.D.
Charity Hospital, Shreveport, La.

Consideration of Errors in the Diagnosis of Intussusception. Mark M. Ravitch. Am. J. Dis. Child. **84:** 17–26, July 1952.

From 1930 to 1951, 98 children with intussusception were treated at the Johns Hopkins Hospital. In 19 of these there was a significant error in diagnosis, causing delay in treatment, and 8 of these children died.

Characteristically, intussusception develops in well nourished boys five to ten months of age. In many children the symptoms and signs of intussusception appear during the course of an upper respiratory infection or a non-specific diarrhea. Infrequently there is a history of previous similar attacks. Abdominal pain begins suddenly and occurs intermittently with increasing frequency. Vomiting is common. One or two normal stools may be passed, after which blood and mucous are all that is discharged. The abdomen is usually soft, and a mass is nearly always palpable externally or by rectum. A significant elevation in temperature and a moderate leukocytosis are common.

The errors in diagnosis in the 19 cases fell into several categories. One typical case was not recognized simply because of the ignorance of the examining physician. In 5 cases the duration of the symptoms was much longer than usual with a final exacerbation. [These were missed because the examiners did not realize there was such a thing as "chronic," non-strangulating intussusception with incomplete obstruction until the final episode.—Z.F.E.] In 5 cases an erroneous diagnosis of dysentery was made, based upon fever, vomiting, bloody stools, and abdominal pain. In 2 cases there was sufficient spasm, rigidity, and tenderness to simulate an acute abdominal condition requiring surgery. Since immediate surgery was indicated, this was not a serious error. Blood in the stools or currant-jelly stools is considered another classic sign of intussusception, but it did not appear at all in 10 of the 19 undiagnosed cases. In 8 of the 19 cases a mass was never felt, and in 8 others it was not palpable at the onset. In some cases the mass was undoubtedly under the costal margin and therefore not palpable. In 7 cases the intussusception involved the ileum only, and in 4 of these a mass was never felt. In 3 cases the intussusception developed while the patients were in the hospital for other conditions, and the change in the clinical picture was not appreciated immediately. One patient with chronic intussusception was given a barium enema which showed the condition, but the picture was wrongly interpreted as normal until a mass became palpable several days later.

In conclusion the author points out that ileoileal intussusception is not only the most difficult to diagnose but also carries the highest mortality. (No mass is palpable and the barium-enema study is normal until the intussusception reaches the cecum.)

[This is an excellent article, giving everyone who reads it the opportunity of learning from the accumulated mistakes of twenty years. The case histories should be read in the original.—Z.F.E.]

Four roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Intestinal Intubation for Barium Produced Bowel Obstruction. Meyer O. Cantor, Bert E. McCollum, and Jason Hodges. Am. J. Digest. Dis. **19:** 148–150, May 1952.

The administration of a barium suspension is considered dangerous in the presence of partial or complete bowel obstruction. In partial obstruction the putty-like barium resulting after absorption of the water from the suspension sometimes causes the obstruction to become complete.

The information to be gained from the use of barium in cases of partial bowel obstruction is so important that the authors have perfected a method for using the barium suspension without risking an obstruction.

Their procedure is to pass an 18 French decompression tube (Cantor tube) through the stomach and small bowel until it reaches the site of obstruction. A barium mixture is then injected into the catheter which causes a puddling at the site of the obstruction. After the study of the area has been completed, the barium is removed by diluting it with large amounts of warm water; the diluted barium solution is then aspirated.

The authors present an illustrative case. A woman, aged 64, was admitted to the hospital with a diagnosis of gallbladder disease. About a month previously she had experienced severe knife-like pains with vomiting and diarrhea. She had had a similar attack about a year before which had cleared up with the use of olive oil and orange juice. On examination her temperature was 99°, pulse 100, respirations 24. The abdomen was not distended, and tenderness was elicted only on palpation in the upper right quadrant. A barium suspension was given according to the above technic, and dilated loops of bowel were visualized with fluid levels. The small bowel pattern suggested a partial obstruction in the lower ileum. For the next three days the bowel was irrigated with 3,000 c.c. of water daily, and at the end of that time a roentgenogram of the abdomen revealed almost no barium.

At operation, an area of constriction was found in the small bowel about 4 inches from the terminal ileum. The constriction was due to acute inflammation and a band which produced a partial obstruction. This band was cut. It was then seen that the lumen of the bowel was constricted by adhesions at this point. When the adhesions were all freed, the bowel resumed its normal size. The patient made an uneventful recovery.

Three roentgenograms. JOSEPH T. DANZER, M.D.
Oil City, Penna.

Surgical Aspects of Intrahepatic Biliary Obstruction. Ian Aird. Ann. Surg. **136:** 27–38, July 1952.

A clinical picture of obstructive jaundice may be produced by several varieties of intrahepatic obstruction of the biliary tract, including intrahepatic stone, hepatoma arising near porta hepatis in relation to the confluence of the right and left hepatic ducts impalpable at operation, and very extensive malignant infiltration of the biliary passages within the liver.

Some patients presenting a clear picture of obstructive jaundice may present no detectable biliary obstruction and may provide a normal operative cholangiogram. The histologic features in such cases may be those of obstructive jaundice or of demonstrable biliary cirrhosis. The normal cholangiogram in these cases seems to justify the use of the term cholangiolitic biliary obstruction.

A curious case of cholangiolitic biliary obstruction, associated with generalized enlargement, reddish discoloration of the upper abdominal lymph nodes (which were filled with pigment presumed to be bilirubin), and occurring in a patient who has been subject to repeated hemorrhages from mucous surfaces and a severe and prolonged anemia is described.

The diagnosis of cholangiolitic biliary obstruction should be applied at operation with diffidence, and it is confirmed only by the continued survival of the patient with progressive and permanent recovery from jaundice. If these conditions are not satisfied the presence of a hepatoma within the liver, and not palpable at laparotomy, must be entertained.

A curious extension of hepatoma into the bile passages to occupy even the whole length of the common duct is described, and its puzzling histologic character, with the presence of well-formed biliary tracts, is discussed.

Normal operative cholangiograms were obtained in 2 patients suffering from biliary xanthomas, and additional evidence is adduced for regarding xanthomatosis as secondary, in some cases, to cholangiolitic obstruction.

Three roentgenograms; 4 photomicrographs; 4 photographs. MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Cholangiography and Its Clinical Status. M. Fóti and Z. Mester. Radiol. clin. **21:** 242–262, July 1952. (In German)

Cholangiography is now thoroughly established as a routine procedure. It is useful both as an immediate cholangiogram, to be done, as first introduced by Mirizzi in 1932, at the time of surgery, and as a late cholangiogram, to be performed whenever an external biliary fistula is present. The delayed study has proved the more essential, with specific value in the detection of retained gallstones, with practical application in showing narrowing and occlusion of the bile ducts, and with some academic as well as clinical interest in regard to functional changes.

The normal common duct varies from 3 to 5 mm. in diameter. It is relatively uniform in caliber and appears slightly larger with Lipiodol than with a water-soluble medium. Intrahepatic reflux and reflux into the duct of Wirsung may be, but is not in itself, abnormal. A stone in the common duct appears as a negative shadow and is best seen with the water-soluble medium; an air bubble may cause confusion with oil contrast. A stone impacted in the ampulla may not be fully outlined but will give the dilated duct an unusual shape, either obviously cupped or bluntly finger shaped.

Cicatrix, tumor, and pancreatitis may all cause mechanical interference with drainage. Under fluoroscopy one sees the finer hepatic radicles fill before the common duct. Cancer of the papilla or the head of the pancreas may produce an enormous distention of the bile ducts. Should the obstruction be not quite complete, a low-viscosity, aqueous contrast solution may reveal a thin, irregular, tortuous channel. If the obstruction is complete, the end of the column of medium is apt to be funnel-shaped. One cannot always determine the precise cause of the obstruction, but cholangiography should always show its presence. Illustrative cases of carcinoma and of pancreatitis are presented.

This method of direct study has already contributed much to our understanding of biliary dyskinesia. It is well-known that some postoperative pain is due to retained calculi. Cholangiography is capable of separating the mechanical group from the functional group and has contributed such concepts as hypertonic dyskinesia, hypotonic dyskinesia, vesicular intolerance and the hepatic syndrome of Mirizzi. In hypertonic dyskinesia the common duct is slightly but uniformly dilated, showing peristaltic waves and intermittent slow emptying into the duodenum. In hypotonic dyskinesia there is also a uniformly dilated common duct but, contrary to the above, peristaltic waves are absent and emptying into the duodenum is rapid. Vesicular intolerance represents a somewhat debatable entity. The term was introduced by French authors during the last war

when, due to inadequate facilities, cholecystostomy was frequently performed, thus permitting many studies of the gallbladder itself. The intolerance is an extremely rapid dumping of the medium from the filled gallbladder into the common duct, dilating that channel even in the absence of any demonstrable obstruction. The hepatic syndrome of Mirizzi is entirely a cholangiographic diagnosis. Presumably the ductus hepaticus possesses a muscular mechanism just above the cystic duct opening; this mechanism in sphincter fashion controls the flow of bile from the liver. The hepatic syndrome occurs when this sphincter occludes the hepatic ducts.

Lastly, cholangiography may permit recognition of a sinus tract or an abscess cavity. An example of the latter is given to balance the observation that the usefulness of cholangiography in this connection is seldom mentioned in the literature.

Thirty-one roentgenograms.

WILLIAM F. WANGNER, M.D.
Royal Oak, Mich.

Definition of Pancreatic Cysts within Pancreatic Calcification. Report of Two Cases. Gilbert H. Alexander and Ralph J. Lowder, Jr. Gastroenterology **21**: 439–443, July 1952.

Two cases are presented in which the presence of a pancreatic cyst was predicted preoperatively on the basis of a spherical defect within a diffusely calcified pancreas. This was confirmed at operation in both instances. In 1 case roentgen examination showed evidence of extrinsic pressure within the duodenal loop. There was also evidence of extrinsic pressure on the posterior aspect of the first segment of the duodenum. In the second case there was evidence of extrinsic pressure on the greater curvature aspect of the antrum and extrinsic pressure within the duodenal loop, as well as widening of the loop. It is felt that a malignant neoplasm would not cause a smooth and even defect within the calcification.

Four roentgenograms.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Differential Diagnosis of Hepatitis and Liver Cirrhosis by Means of Cholecystography. Klaus A. J. Järvinen and Vilho E. Paltia. Am. J. Digest. Dis. **19**: 244–248, August 1952.

Our increased knowledge of the position of the liver in the various metabolic processes has made possible a more accurate diagnosis of the diseases affecting it. To make these diagnoses, however, it is necessary to have extensive laboratory facilities usually not available to an independent practitioner. With the help of a good history, it is usually possible to differentiate diffuse lesions of the liver from diseases of the gallbladder and bile ducts and from diseases associated with hemolysis. It is more difficult to say to which type of diffuse liver lesion an actual case belongs. The authors describe an attempt to determine whether this diagnostic problem can be solved with the aid of x-ray examination of the gallbladder.

As early as 1924, it was known to Graham and his co-workers that the secretion of a radiopaque substance into the bile ducts and gallbladder was dependent on the function of the liver. The relation of liver function and cholecystography has been the subject of several studies, and it is generally agreed that cholecystography is usually unsuccessful in liver cirrhosis. Blomström and Sandström showed that if the retention of bromsulphthalein is at or above 40 per cent a gallbladder cannot be visualized; if the concentration is below 30 per cent, however, a distinct shadow will be observed. Bockus states that if a patient has retained as much as 25 per cent of bromsulfphthalein in the blood for one-half hour after injection it is possible to demonstrate a satisfactory gallbladder shadow.

Theoretically, the compounds used in cholecystography are both physically and chemically related to sodium tetrabromphenolphthalein, which is used in the bromsulphthalein test, and both tests depend upon the ability of the liver to eliminate this substance from the blood into the bile. The bromsulphthalein test is one of the best, if not the best, test of liver function. It is, of course, of no value if there is an obstruction of the bile ducts causing jaundice.

Other possible sources of error limiting the value of cholecystography as a liver function test are (1) lack of absorption from the intestinal tract, (2) obstruction of the cystic duct or absence of the gallbladder, (3) a decrease in the concentrating capacity of the gallbladder, and (4) the presence of pernicious anemia, exophthalmic goiter, and sometimes diabetes. All these sources of error can be excluded by the history and physical examination except obstruction of the cystic duct and a poorly concentrating gallbladder; in most of these cases the gallbladder can be demonstrated or the presence of stones shown.

The material for the authors' study consisted of 23 cases of acute and chronic hepatitis, 11 of which were in males, and 23 cases of cirrhosis, 16 of which were in males. As a control, cholecystography was performed in 44 patients suffering from peptic ulcer. The patients were all given a contrast medium in the usual amounts, and films were taken sixteen to eighteen hours later. The films were read as "good filling," "poor filling," and "no filling." Four cases from each group having an icterus index over $^1/_{10}$ were eliminated, as it has been shown that filling of the gallbladder does not occur with an icterus index over this level.

The shadow of the gallbladder appeared to be normal in 15 cases of hepatitis and was less dense than normal in 3 cases. In 1 case in which gallstones were present, the gallbladder was not visualized at all. The gallbladder shadow did not appear normal in any of the cases of cirrhosis; in 6 cases a slight shadow was present, and in 13 cases no shadow was seen.

It is apparent from this series of cases that the gallbladder functions well in cases with hepatitis and very poorly or not at all in cases of cirrhosis. It is true, of course, that cholecystography only gives information as to the secreting and excreting functions of the liver. The same may be said of the bromsulphthalein test.

It is the opinion of the authors that cholecystography can be of help in differential diagnosis of various diffuse hepatic affections, particularly when laboratory facilities are limited.

JOSEPH T. DANZER, M.D.
Oil City, Penna.

Cholecystography—The Role of the Stomach Antrum in the Interpretation of Radiographs. Magnus I. Smedal. S. Clin. North America **32**: 847–850, June 1952.

Some of the errors associated with cholecystography occur in the interpretation of borderline or faint concentrations of the contrast medium by the gallbladder.

One error is mistaking the soft-tissue shadow produced by distention of the stomach antrum for a faintly filled gallbladder. It is a fallacious assumption to infer that the gallbladder is better visualized after a fatty meal. Confusion with the distended antrum is most apt to occur at that time. Additional oblique films and even the ingestion of barium to outline the antrum (rounded outline) is of greatest assistance in the differential diagnosis. Correcting this error will increase the accuracy of diagnosis of gallbladder disease.

Twelve roentgenograms.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

THE MUSCULOSKELETAL SYSTEM

Multiple Epiphysial Dysplasia. A Report of Four Cases. J. Kennedy Watt. Brit. J. Surg. **39:** 533–535, May 1952.

The author presents 4 new cases of multiple epiphysial dysplasia, with roentgenograms of various involved epiphyses. The disease is usually first observed in young adults or children. As a rule the patients are of small stature, due to underdevelopment of the limbs rather than of the trunk. The common initial complaint is difficulty in walking or of pain in the hips or knees. Sometimes other joints are involved. Diagnosis is based mainly on the radiologic findings, consisting in symmetrical alterations in the shape of the epiphyses contrasting sharply with the normal appearance of the diaphyses. The epiphysial changes are usually most marked at the hips, shoulders, and ankles. Tilting of the plane of the ankle joint bilaterally is common.

Two of the author's cases were in siblings. The author thinks that a hereditary factor may play a role in multiple epiphysial dysplasia, but in the majority of cases there is little evidence of a hereditary or familial tendency.

Six roentgenograms.

SIDNEY KING, M.D.
Hancock, Mich.

Mediterranean Hemopathic Syndromes (Cooley's Anemia) in Adults. Study of a Family with Unusual Complications. Harold W. March, Samuel M. Schlyen, and Samuel E. Schwartz. Am. J. Med. **13:** 46–57, July 1952.

The authors present an interesting review of Cooley's anemia (Mediterranean anemia), especially as seen in the United States, and report cases in 3 of 6 siblings born of Italian parents.

All criteria for the severe form of the disease were present in these patients, who were in the fourth and fifth decades of life. On radiographic examination, widely disseminated bone changes were apparent, corresponding exactly to these described by Caffey (Am. J. Roentgenol. **37:** 293, 1937. Abst. in Radiology **30:** 264, 1938). The basic process was osteoporosis, expansion of the marrow cavity, cortical attenuation, and compensatory striation. In the skull the "hair-on-end" appearance was seen; in the distal end of the tibia expansion of the medullary structure resulted in a flask-shaped appearance; in the hands, vertebrae and sacrum interlacing bands of varying density produced a mosaic pattern.

Complicating features of the disease included leg ulcers and hyperuricemia which in 1 patient resulted in urate calculi and in another expressed itself as gouty arthritis. Pleuropericarditis which responded to Cortisone is described in 1 of the patients, and its relationship to the basic disease is discussed.

Eigbt illustrations, including 4 roentgenograms.

Chronic Idiopathic Hypertrophic Osteoarthropathy. Report of a Case and Review of Literature. Morris Berk. New England J. Med. **247:** 123–126, July 24, 1952.

Chronic idiopathic hypertrophic osteoarthropathy is described as a condition occurring predominantly in males at puberty or adolescence and characterized by clubbing of the digits, enlargement of the bones and joints, and thickening of the skin of the face, in the absence of any demonstrable primary disease. (Camp and Scanlan: Radiology **50:** 581–593, 1948). It is important to differentiate this condition from secondary hypertrophic osteoarthropathy, which not infrequently antedates an underlying neoplasm of the lung.

Systemic manifestations of idiopathic hypertrophic osteoarthropathy are minimal. The greatest disability occurs in the bone. Bony enlargement is due to lateral growth and usually causes few symptoms other than deformity and low-grade pain. Roentgenologic features are characteristic and consist chiefly of a slowly progressive ossifying periostitis, beginning at the distal ends of the diaphysis and later involving the entire shaft. These changes are commonest at the lower ends of the legs and forearms. The medullary cavity remains normal. Joint involvement is late and is most often seen adjacent to the involved bones.

The onset of the osteoarthropathy in puberty and the presence of ungual tufting, abdominal striae and mongoloid facies suggest a probable endocrine etiology. Complete disappearance of these signs is never noted in hereditary or idiopathic clubbing. It is likely that simple club fingers, without obvious underlying etiology, represents idiopathic osteoarthropathy of milder degree.

A case is reported of a 25-year-old male who had had pain in the legs and ankles for four years. His digits were clubbed, and a bone survey revealed extensive periosteal changes and cortical thickening involving the lower tibia, fibula, radius, ulna, and femur, bilaterally. There was increased tufting of the distal phalanges of both hands. Chest studies were normal. No cause for the pathology could be found, and the case is said to be one of idiopathic origin.

Six roentgenograms; 2 bronchospirograms; 3 tables.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Giant-Cell Tumours, Osteitis Fibrosa, and Bone Cysts. R. McWhirter. J. Fac. Radiologists **4:** 1–9, July 1952.

The author stresses that a satisfactory classification of disease is of the greatest importance. He suggests that giant-cell tumors, osteitis fibrosa, and bone cysts are all variants of the same process and that a suitable term to include all three lesions would be "dysfibroplasia," thus bringing this group of lesions into line with the cartilaginous areas of development known as "dyschondroplasia." The vascularity of the lesion is the essential factor which determines the histological findings. The vascularity in turn is dependent on the stage at which the error in development at the epiphysial plate took place. Giant-cell tumors should no longer be regarded as true tumors, just as the "chondromata"

of dyschondroplasia and the "osteomata" of diaphysial aclasis are no longer regarded as neoplasms.

The case of a 25-year-old woman, with an original diagnosis of giant-cell tumor of the right radius, is presented. X-ray therapy was given for a minimal tumor dose of 2,500 r. The patient had a baby about a year later which she nursed. During the period of lactation the tumor gradually increased in size until it was larger than it had been originally. The course of x-ray therapy was repeated. The tumor again became smaller until the patient became pregnant a second time. During the latter part of pregnancy the tumor increased in size. A biopsy after delivery of the baby was reported as showing an osteogenic sarcoma accompanied by giant-cell reaction. The arm was amputated just above the level of the elbow joint; the histologic diagnosis of the whole tumor was again osteogenic sarcoma. The tissue has been re-examined recently, and the diagnosis of osteogenic sarcoma has now been doubted. The fact that the patient has not developed metastases suggests that the lesion had not become malignant.

The author believes that when giant-cell tumors appear to have become malignant, and especially where this change has been reported as occurring within a comparatively short time, it is probable that the tumor was malignant from the beginning, *i.e.*, that it was an osteogenic sarcoma with a high giant-cell content. The author believes that it is a rare event for a typical giant-cell tumor to become malignant.

Fourteen roentgenograms. A. W. BROWN, M.D.
Charity Hospital, Shreveport, La.

An Osteoclastoma of the Skull. G. F. Rowbotham. Brit. J. Surg. **39:** 527–529, May 1952.

Though the osteoclastoma is a well known tumor of the bones of the limbs and face, its occurrence in the skull is rare, only 3 cases having been described in the British literature during the present century. The author reports a case which was studied over a period of years, making possible observations on the rate of growth of the tumor, its mode of spread and its tendency to compress the brain. Serial roentgenograms and a photograph of the patient at an advanced stage of the disease are reproduced.

The behavior of the tumor was essentially benign throughout its course. There was never a sign of a metastatic deposit elsewhere in the body. The tumor, however, expanded the skull outward and expanded the inner table inwardly, producing considerable compression of the cerebral cortex.

Five roentgenograms; 1 photograph; 3 photomicrographs. SIDNEY KING, M.D.
Hancock, Mich.

Osteochondritis Dissecans. Frank L. Shipp. S Clin. North America **32:** 713–719, June 1952.

Most studies have apparently established that trauma, either intra-articular or extra-articular, plays an important part in the production of osteochondritis dissecans. This theory is supported by the fact that many cases appear during adolescence.

The areas where osteochondritis dissecans occurs are those exposed to trauma. They also represent joint surfaces in which the articular blood supply may be barely sufficient for normal wear and tear. The author believes that repeated subclinical trauma or, less commonly, a major injury to such a critical area may so interrupt the blood supply of subchondral bone as to produce necrosis. Occasionally similar lesions may develop in multiple joints, in which event the role of any constitutional factor is still to be determined.

Initial pathologic changes are the production of a serous effusion and a roughening of the cartilage. This is followed by softening and a lifting of a fragment of bone suggesting a vesicle.

The involved area behaves in several ways: (1) The fragment may become detached, remain *in situ*, be covered by pannus formation and be revascularized. Healing takes place by fibrous displacement; (2) The cartilage and bone may separate completely from their bed, to form a loose body. The loose body may become fibrocartilaginous; (3) The loose body may remain attached by a vascular pedicle or may develop a synovial attachment in some recess of the joint.

Radiographically, at first, one sees a relative zone of increased density surrounded by a zone of lessened density. When complete separation occurs a loose body can be found anywhere in the joint space. The most common sites of involvement are (1) the anterolateral aspect of the medial femoral condyle, (2) the superior and lateral aspect of the femoral head, and (3) the inferior aspect of the humeral capitellum.

The author favors radical surgical treatment for all cases.

Eight roentgenograms.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Periosteal Chondroma. A Distinctive Benign Cartilage Tumor. Louis Lichtenstein and John E. Hall. J. Bone & Joint Surg. **34–A:** 691–697, July 1952.

Periosteal chondroma is a distinct type of benign cartilage tumor which apparently arises in the periosteum. The authors were able to find only 2 probable examples of this tumor in the literature. Although the present study is based on the findings in 6 cases, the tumor probably is not rare. It has apparently not been generally recognized by surgeons and roentgenologists.

Periosteal chondroma is a slowly growing neoplasm which develops within and beneath the periosteal connective tissue and characteristically erodes the contiguous cortical bone, inducing sclerosis. In the authors' cases, the tumor was located in the bones of the hand, foot, and wrist, and in the large limb bones. It was found in children and adults of both sexes. The symptoms were pain, gradual swelling, and local tenderness, of from a few months to ten years duration. Physical examination revealed a firm, generally small, slightly tender tumor which, if located near a joint, caused limitation of motion.

The roentgenographic appearance of periosteal chondroma is distinctive. It consists of a comparatively small, peculiar trough-like hollow or declivity in the cortex, the base of which is made up of sclerotized cortical bone. Small areas of increased density may be present within the area of erosion, indicating calcification or ossification within the cartilage. In views in which the lesion is projected over the bone shaft, a false impression of a central tumor resembling an enchondroma may be produced.

At operation a firm, rubbery, lobulated cartilage tumor is found. This is very adherent to the periosteum and is located partially within the eroded area of the bone cortex. Microscopic study shows these tumors

are composed of lobules of hyaline cartilage. The nests of cartilage cells are often more compact than those of enchondroma and the cell nuclei are plumper. Such an appearance, if seen in an enchondroma, would be suggestive of chondrosarcoma. However, follow-up studies indicate that these changes in a periosteal chondroma do not indicate malignancy.

The treatment in most cases of periosteal chondroma is surgical removal of the tumor, with curettement of the eroded, sclerotized cortical base. If the tumor is fairly large and involves a long limb bone, block excision of the lesion may be feasible. Roentgen therapy is not felt to be indicated because of its ineffectiveness in cartilage tumors. Follow-up studies of the 6 cases have shown no evidence of recurrence after periods of one to three years.

Six roentgenograms; 1 photograph; 3 microphotographs.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

Intervertebral Disc Herniations in the Thoracic Region. Robert L. Imler and Adolph L. Sahs. J. Iowa State M. Soc. **42**: 151–153, April 1952.

Two cases of herniation of an intervertebral disk occurring in the thoracic spine are reported. In both instances the herniation was in the mid-line. These cases presented the rather bizarre clinical picture characteristic of herniations in the thoracic region. Both cases were diagnosed on the basis of myelograms. In 1 case there was narrowing of the thoracic disk spaces; in the other the disk spaces were normal.

The authors briefly review the recent literature dealing with the subject and discuss the clinical picture associated with the condition. The symptom pattern in thoracic disk herniations is not as typical as in herniations of cervical and lumbar disks. Three syndromes dependent upon the location of the disk have been defined: herniation in the upper dorsal region producing symptoms characterized as being clinically similar to those of cervical disk herniation; herniations in the mid-dorsal region producing radicular pain in the involved dermatomes, in the past often called pleurodynia, intercostal neuralgia, arthritis, neuritis, and fibrositis; herniations involving the lower dorsal region, characterized by atypical symptoms, referable to the abdominal viscera, flanks, and inguinal regions.

Two roentgenograms.

SIDNEY KING, M.D.
Hancock, Mich.

Pantopaque Myelography in Low Back and Sciatic Pain: Indications and Technic. G. Edmund Haggart and William R. Grannis. S. Clin. North America **32**: 695–703, June 1952.

Myelography has been used routinely to clarify the diagnosis in patients complaining of low back and sciatic pain. This study is indicated (1) in patients who describe low back pain with or without radiation to the extremities, in whom a diagnosis is not established clinically and by routine roentgenologic and laboratory examinations; (2) to confirm the clinical diagnosis of protruded intervertebral disk, localize the lesion, and determine whether multiple disk protrusions are present; (3) in patients with recurrent or persistent symptoms, who have had previous spine operations; (4) in patients on whom spine fusion is contemplated, with particular reference to cases of spondylolisthesis; (5) to rule out space-occupying lesions in patients on whom the diagnosis of degenerative spinal cord disease is entertained.

An excellent historical summary of the various media used in myelography is given, including air (gas), thorotrast, water-soluble substances, and iodized oil.

The authors use 6 c.c. of Pantopaque. This is injected through a needle entering the third lumbar interspace because 93 per cent of all disk protrusions are below this level. The medium is subsequently withdrawn after the examination by pooling the oil about the needle point.

Anomalous deformities and disturbing outline changes are discussed.

Four roentgenograms.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Stratigraphy (or Tomography) in Some Cases of Vertebral Lesions. Gaetano Tricomi. J. radiol. et d'électrol. **33**: 349–363, 1952. (In French)

For some time the author and his associates have utilized body section roentgenography in the study of bones. In certain cases the anatomic changes are more clearly delineated than with ordinary x-ray studies, and it is possible to arrive at a more accurate diagnosis. An early and correct diagnosis is especially important when it may influence treatment, for example, in early tuberculous lesions of the spine. In the upper cervical region anatomic features are more distinctly shown by this technic, and fractures as well as disease processes may be more clearly demonstrated. In cases of metastatic carcinoma, congenital defects, arthritic processes, and Kümmel's disease, a more strict delineation of pathologic changes is obtained.

Thirty-five roentgenograms.

CHARLES M. NICE, M.D.
University of Minnesota

Vertebral Osteomyelitis Following Paravertebral Block of the Sympathetic Trunk. A. Laur and C. Keller. Fortschr. a. d. Geb. d. Röntgenstrahlen **77**: 81–89, July 1952. (In German)

The diagnosis of non-specific vertebral osteomyelitis is difficult and is usually not made until fairly late for the following reasons: The disease is so rare that one does not often think of it (only 2 per cent of all cases of osteomyelitis are located in the spine); the symptoms are not very characteristic and may suggest a paranephritic abscess, rheumatism, sciatica, diseases of the meninges or tumors; and the x-ray findings are negative in the early stages.

The authors present 2 cases of vertebral osteomyelitis in which a causal relationship to a preceding paravertebral block of the sympathetic trunk was clearly established. A paravertebral block of the sympathetic trunk is often made for the relief of intractable pain due to gangrene or other infectious processes within the leg. The author believes that some infectious material travels upward and contaminates the paravertebral lymph channels. In making the block, the surgeon penetrates the contaminated lymph channels with the needle and, in feeling his way along the side of the vertebral bodies, he pierces the periosteum and implants the infection in the bone.

The clinical findings are severe pain in the back following the paravertebral injection, reflex muscular spasm, elevation of temperature, leukocytosis, and

more or less metorism. The latter is undoubtedly due to the inflammatory changes around the sympathetic trunks. The pain lasts several weeks or months. The roentgen findings are negative in the beginning. After three to four weeks, however, x-ray examination shows an erosion along the sides of the vertebral bodies or anteriorly and perhaps some narrowing of the disk spaces. These changes often extend over several vertebral bodies. After some more weeks definite calcifications develop, sometimes forming bridges across the vertebral bodies.

In the differential diagnosis it is most important to consider tuberculosis. In the early stages distinction between tuberculosis and osteomyelitis will probably be impossible. Later in the course of the disease, the tendency to develop calcific deposits, the absence of a gibbus, and the spread of the process over a larger number of vertebral bodies will establish the diagnosis of osteomyelitis. A further sign of vertebral osteomyelitis is the fact that the destruction is mostly marginal and does not involve the entire vertebral body.

Treatment in the authors' 2 cases was conservative, with recovery within a few months. In 1 case, in the early stages, a laparotomy was performed because the marked abdominal distention was incorrectly attributed to an obstruction. The authors think the use of antibiotics will be helpful but did not use them in their cases.

Sixteen roentgenograms.

WM. A. MARSHALL, M.D.
Chicago, Ill.

Osteomyelitis Due to Salmonella Infection. L. Giaccai and H. Idriss. J. Pediat. **41**: 73–78, July 1952.

Osteomyelitis as a complication of Salmonella infections is a rare occurrence. Thus far only 27 cases of osteomyelitis due to salmonella other than *Salmonella typhi* or *Salmonella paratyphi B* have been reported in the world literature. The disease differs in these 27 cases from that of typhoid fever or paratyphoid B in that it is practically met with only in the young age groups, and chiefly in infants.

The long bones, especially the femur and humerus, and the chondrosternal junction are the most frequent skeletal localizations of *Salmonella* osteomyelitis. Next in order is the spine, in which more than one vertebral body is usually affected. Frequently multiple localizations occur; in about 15 per cent of the reported cases, several bones were affected at the same time. The disease process appears to involve the diaphysis more frequently than the metaphysis, in which respect it differs from pyogenic osteomyelitis. The epiphysis is also a frequent site of primary involvement.

As compared with the common pyogenic osteomyelitis, *Salmonella* infections are usually less destructive, and the bony lesions are likely to heal completely in a shorter period of time. In the majority of reported cases, osteomyelitis occurred several weeks or some months after the acute gastrointestinal manifestations of infection.

A case of osteomyelitis due to *Salmonella enteritidis* is reported. Rapid repair followed treatment with Chloromycetin, but low-grade infection with repeated flare-ups still persisted five years after the onset of the disease. The original lesion consisted of a destructive process of the lower third of the right tibia. A pathological fracture subsequently developed. Roentgenograms six months later revealed complete repair of the fracture, but at the site, the cortical bone was condensed and slightly thickened and at its center there was a small rounded area of rarefaction representing a bone abscess. This abscess persisted for a period of two years without evidence of healing.

Three roentgenograms.

HOWARD L. STEINBACH, M.D.
San Francisco, Calif.

Observations upon the Role of the Sex Hormones in the Development of Bony Pelvic Conformation. Daniel G. Morton and Gilbert Gordan. Am. J. Obst. & Gynec. **64**: 292–300, August 1952.

The authors submit that the bony pelves of prepuberal children of different sexes are remarkably alike and that there is a striking dissimilarity in the two sexes after puberty. They consider the question of whether the sex hormones play a major role in producing the sexual characteristics of adult pelves even though the fundamental determinant might be chromosomal.

Roentgenographic study of the pelves of individuals of marked sexual immaturity was attempted to see if these pelves were of the indeterminate pre-adolescent type or if they differed from the normal. Thirteen hypogonadal males between the ages of seventeen and forty-three, and 5 hypogonadal females between fifteen and thirty years were studied.

Normally the bones of the adult male pelvis are heavier than in the female. It is higher, and the side walls in most instances converge slightly toward the outlet. The lower part of the sacrum usually bends forward. The male sacrosciatic notch tends to be narrower than in the female. The inlet is of the "blunt heart" shape rather than a smooth ovoid, as in the female. The greatest transverse diameter at the inlet is closer to the sacral promontory in the male, and the anterior portion of the inlet is elongated anteroposteriorly, with narrowing toward the symphysis.

The pre-adolescent pelvis is characterized as an elongated inlet with the anteroposterior diameter exceeding the greatest transverse diameter, inward bowing of the acetabular regions at the inlet, light bones, medium subpelvic arch, and a rather high pelvis.

In all 13 male patients, treated and untreated, the pelvis showed android features. The 8 treated patients all responded well to androgen therapy in development of secondary sexual characteristics. One showed pre-adolescent pelvic features, and 4 showed possible evidence of gynecoid features in the forepelvis. Of the 5 untreated patients, 3 showed pre-adolescent features and 4 showed gynecoid features in the forepelvis. The earliest age at which androgenic treatment was started was twenty years. Since the pelvis has acquired its adult form at this age, the evidence that treatment affected pelvic development must be regarded cautiously.

In all 5 of the females studied, the pelvic bones were light and suggested the female. In 3 cases there were android features as well.

The authors conclude that the characteristics of the adult bony pelvis are apparently not dependent primarily on normal concentrations of the sex hormones, although these may aid in the maturation of the pelvis in the proper direction.

Seven roentgenograms; 4 tables.

MASON WHITMORE, M.D.
Jefferson Medical College

A Technique for Arthrography of the Hip. Abel Kenin and Jack Levine. Am. J. Roentgenol. **68:** 107–111, July 1952.

The greatest application of arthrography of the hip thus far has been in the study of congenital dysplasia and dislocation. Often the clinical impression of an experienced observer based upon physical findings and flat roentgenograms of the hips is proved erroneous by arthrography.

The authors believe that arthrography of the hip has not been given the attention it merits in this country because of the technical difficulties encountered with previously described methods of injection, and that the salient anatomical features of the normal and pathological hip joint are clearly demonstrated in the arthrogram properly performed. They describe a technic for arthrography which they feel is simple and endangers no delicate structures. Examples of its value are given.

Thirteen roentgenograms; 2 drawings.

A. J. NICHOLAS, M.D.
Charity Hospital, Shreveport, La.

The Early Diagnosis of Flat-Headed Femur. J. H. Kite and G. O. French. South. M. J. **45:** 581–584, July 1952.

The early symptoms and roentgenographic signs of flat-headed femur (osteochondritis deformans coxae juvenilis, coxa plana) are discussed to aid in earlier recognition of this condition. Symptoms precede roentgen changes. The authors feel that the diagnosis should be made before decalcification and fragmentation occur.

Of 165 cases of flat-headed femur studied by the authors, 86 per cent occurred in boys. The commonest complaint was pain in the thigh or knee after an injury or overexertion, disappearing after rest. Usually at about the same time a limp was noticed, which disappeared after rest and recurred after exertion. Two early physical findings were limitation of internal rotation and a slight limitation of full abduction.

Four early roentgenographic signs for the diagnosis of flat-headed femur are: Waldenström's sign, a lateral displacement of the femur from the medial wall of the acetabulum; the obturator sign, a reduction in the size of the obturator foramen on the diseased side, due to slight rotation of the pelvis; the "roof" sign, so called because a flattening of the lateral side of the femoral head in the anteroposterior view, with the slight flattening of the medial convexity of the head, gives the appearance of a roof. The fourth sign is a measurement of the bone atrophy on the involved side (on the roentgenogram) with a photoelectric light meter, the bone atrophy in the early case causing a difference in reading of one or more points between the two hips.

Five roentgenograms.

WARREN A. NAFIS, M.D.
Jefferson Medical College

Familial and Sporadic Neurogenic Acro-Osteolysis. L. Giaccai. Acta radiol. **38:** 17–29, July 1952.

Chronic perforating ulcers of the extremities associated with changes in the underlying bone structures are of common occurrence in tabes dorsalis, syringomyelia, spinal cord tumors, and other neurologic lesions, causing abolition or impairment of sensory function. In addition to these "symptomatic" types, there are two types of "essential" neurogenic osteopathies, the one occurring with a familial incidence and the other sporadically. They differ from each other in certain roentgen and clinicial aspects.

Familial neurogenic acro-osteolysis is characterized by chronic ulceration resulting in extensive mutilation of the feet and sensory disturbances in the extremities. Sixty-eight typical cases have been reported. The ratio of males to females is 3 to 1. The disease characteristically appears as a painful ulceration on the plantar aspect of the foot, which grows in size and soon discharges fragments of bone from its depths. The ulcer then heals; after an interval of a few weeks or months the process repeats itself at another site. Subsequently, the other foot is involved. The feet become chronically swollen, deformed, and mutilated. From a roentgenologic standpoint, osteomyelitic changes appear first in the heads of the first or second metatarsal bones, with areas of irregular bone rarefaction, sclerosis, and destruction; formation of sequestra is followed by progressive fragmentation of the shaft and distal epiphysis. In the phalanges, the process may be found uncomplicated by osteomyelitis, and here there is "concentric bone atrophy," *i.e.*, the shafts are thinned out toward the epiphyses which are unaffected until the late stages. When the shafts have been completely destroyed, the epiphyses remain as loose fragments, which finally undergo resorption or are eliminated as sequestra.

The non-familial or sporadic type of acro-osteolysis is more common than the familial and differs from it in the following ways: (1) It is often unilateral. (2) The sensory disturbances of the foot are inconstant. (3) It is almost always associated with demonstrable congenital malformations of the spine and of the foot. (4) There is no definite sex incidence. (5) Progress of the disease is more rapid.

Apart from the distribution of the skeletal changes which varies according to the level of the spinal lesion, the following features are common to the osteoarthritic changes in tabes dorsalis, syringomyelia, or any other lesion of the sensory system of the spinal tract. (1) The large proximal joints are predominantly affected. (2) The articular portions of the bones involved show a mixed destructive and reactive process (osteoporosis, coarse roughening of the articular surfaces, bone reaction and condensation with osteophytic proliferation).

On the other hand, in both familial and non-familial acro-osteolysis, the bone changes may be summarized as follows: (1) progressive destruction of the distal bones of the feet without joint involvement, (2) changes exclusively of the osteolytic type, with no signs of reaction in the remaining bones.

Eight roentgenograms; 4 photographs; 1 table.

I. R. BERGER, M.D.
VA Hospital, Atlanta, Ga.

Calcification Adjacent to the Pisiform Bone. George S. Phalen. J. Bone & Joint Surg. **34-A:** 579–583, July 1952.

The term "calcified pisiform bursitis" is used to designate a clinical syndrome consisting of pain over the pisiform bone and weakness of grip, associated with calcific deposit adjacent to the pisiform bone. Occasionally there is redness of the skin overlying this region. Anatomically, there is no structure designated as the pisiform bursa. The calcific deposit is located either within the tendon of the flexor carpi ulnaris muscle or in the bursa of this muscle. The bursa

is situated immediately beneath the tendon near its insertion into the pisiform bone.

The diagnosis of calcified pisiform bursitis is frequently missed because the calcification is not visible in anteroposterior and lateral views. It can usually be demonstrated only with a roentgenogram made obliquely through the wrist with the forearm in midsupination. This position places the pisiform bone apart from the other carpal bones and reveals the soft-tissue calcification which may be present in this region.

The majority of patients with this condition are cured promptly by local infiltration of the calcified area with novocain. The author states that while roentgen therapy should be as effective in this condition as in calcific bursitis or tendinitis of the shoulder, he did not treat a sufficient number of cases by this method to make any conclusions as to its efficacy. He feels that roentgen therapy should probably be reserved for the infrequent cases of calcific pisiform bursitis, with evidence of an associated acute cellulitis. Surgical treatment by excision of the bursa or the calcified area is indicated only in the cases in which more conservative methods fail.

Five roentgenograms; 1 photograph; 1 photomicrograph.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

GYNECOLOGY AND OBSTETRICS

The Roentgenographic Diagnosis of Endometritis Hyperplastica Ovarialis. Salvatore di Palma and S. L. Beranbaum. Am. J. Obst. & Gynec. **64:** 162–167, July 1952.

Endometritis hyperplastica ovarialis is considered by the authors "a definite endocrine entity characterized by uterine bleeding from a mucosa having the characteristics of an endometrial overgrowth due to the absence of normal ovulation and corpus luteum formation." Positive diagnosis can be made by the history and the microscopic appearance of the endometrium. A case is reported to stress the roentgen findings, which have not previously been described. The hysterosalpingogram showed a typical "swiss cheese" crisscross defect in accord with the pathological findings.

Two roentgenograms.

JOHN M. KOHL, M.D.
Jefferson Medical College

Pelvic Pneumoperitoneum: The X-Ray Appearance of the Normal Female Pelvic Organs. J. Gershon-Cohen and M. B. Hermel. Am. J. Obst. & Gynec. **64:** 184–187, July 1952.

Pelvic pneumoperitoneum was used to study the appearance of normal pelvic organs in a group of 30 women with pulmonary tuberculosis in whom the procedure had been carried out for therapy. With the bladder and rectum emptied, a pneumoperitoneum is established with 500 to 1,000 c.c. of carbon dioxide either by the transabdominal or transuterine route. The patient is placed face down on the x-ray table with her thighs elevated on two pillows, and the air is compressed into the pelvis by means of an air pillow under the epigastrium. The x-ray beam is angled 20 degrees cephalad through the pelvic canal. Technical factors used by the authors were 80 kv., 300 ma., 40 inches distance, and a 16 to 1 ratio grid in the Potter-Bucky diaphragm. An excellent outline of the uterus, tubes, ovaries, round ligaments, bladder, rectum, and other pelvic contents is obtained. Slightly oblique views are occasionally necessary to project the ovaries away from the pelvic brim.

The authors believe that with this technic congenital defects such as malposition or hypoplasia of the tubes, ovaries, and uterus may be recognized quickly, as well as small tumors and tubal pregnancy. Indications and contraindications for the transabdominal and transuterine methods of pelvic pneumoperitoneum are given, as well as the normal positions and measurements of the pelvic organs visualized.

Five roentgenograms; 1 table.

WARREN A. NAFIS, M.D.
Jefferson Medical College

Classification of Forceps Operations According to Uniform Radiological and Clinical Criteria. Arthur Weinberg. Am. J. Obst. & Gynec. **64:** 371–375, August 1952.

Three classifications of forceps operations have recently been proposed.

The first includes three types.

1. High forceps: Application before engagement has taken place, which is demonstrated clinically by occurrence of the presenting part above the ischial spine.
2. Low forceps: Application when the head is visible, the skull on the perineal floor and the sagittal suture on the pelvic anteroposterior diameter.
3. Mid forceps: Application before low forceps criteria have been met, but after engagement.

The second classification is based on the station of the biparietal diameter to the four major pelvic planes.

1. High forceps: The biparietal diameter is in the inlet or superior strait and the leading bony point of the head just above the ischial spines. Anything higher should be labeled a forceps application to an unengaged head.
2. Mid forceps: The leading bony point of the head is at or just below the ischial spine, with the biparietal diameter below the superior strait. The head nearly fills the hollow of the sacrum.
3. Low mid forceps: The biparietal diameter is at or below the ischial spines. The leading point is within a fingerbreadth of the perineum between contractions. The head completely fills the hollow of the sacrum.
4. Low forceps: The bony head is on the perineum between contractions and is visible during contractions. The biparietal diameter is judged to be below the ischial spine with the sagittal suture in or nearly in the anteroposterior diameter of the inlet.

The third classification is based entirely on bony landmarks.

1. High forceps: The leading bony point is between the inlet and ischial spines, approaching the spines so that the presenting part is engaged. An operation higher than this would be termed a "floating forceps."
2. Mid forceps: The presenting part is between the ischial spine and tuberosities.
3. Low forceps: The leading point is below the ischial tuberosities.
4. Outlet forceps: The presenting part is easily visible and is distending the perineum and vulva.

The author discusses the advantages and disadvantages of each classification. From a clinical and radiological point of view the third, based on bony landmarks, seems to offer the least objection, gives accurate information, and should be generally acceptable.

Two drawings.

MASON WHITMORE, M.D.
Jefferson Medical College

Secondary Abdominal Pregnancy of Five Months' Duration Terminated by Laparotomy. J. A. Klieger and J. R. Evrard. Wisconsin M. J. **51**: 672–673, July 1952.

The author reports a case of secondary abdominal pregnancy.

The patient was first seen at approximately five months gestation, complaining of abdominal pain and intermittent vaginal spotting. There was a mass in the left lower quadrant. A maternal souffle was heard in this area, but no fetal heart sounds were audible. A flat film revealed an apparently dead fetus on the left side of the abdomen.

Lipiodol was injected into the uterus, and a roentgenogram showed a triangular shadow in the left hemipelvis anterior to the fetal skull. It was moderately enlarged. No peritoneal spill was found in twenty-four hours.

At operation the uterus was one and a half times normal size; the left tube and ovary were not grossly remarkable. The right tube was distended; a large placenta was attached to the fimbriated end of the tube and to the peritoneum of the right iliac fossa. The cord reached across to the left side into a mass of adhesions and a macerated fetus.

The right tube was amputated, but the portion of the placenta adherent to the peritoneum was not disturbed. The fetus and umbilical cord were dissected away from the bowel and adhesions and were removed. The postoperative course was uneventful, with normal involution of the pelvic organs.

Three roentgenograms; one photograph.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Placental Calcification. John Dawson. J. Fac. Radiologists **4**: 64–72, July 1952.

Calcification of the placenta is recognized as a common occurrence; it can be seen grossly or with a hand lens in the form of small grayish-white gritty particles scattered over the maternal surface. The process is considered normal in pregnancies near term and has no clinical significance in the diagnosis of disease.

The degree of placental calcification appears to be related to the presence of calcium and vitamins in the diet. Brehm (Ohio State M. J. **33**: 990, 1937) established that "Viosterol" in the maternal diet tended to produce a marked degree of calcification.

Reports of placental calcification which has been demonstrated on antenatal roentgenograms are rare. The author found in his series that calcification of the placenta can frequently be visualized when the placenta is implanted on the anterior uterine wall, and this is a diagnostic factor both in localization of the placenta and determination of its extent. It is usually only possible to demonstrate calcium in the placenta on a tangential lateral view. Radiographic factors are 55 kv. and 100 ma. at 36 inch distance.

The practical application of this phenomenon is in the diagnosis of placenta praevia, but it is usually only of value when implantation occurs on the anterior uterine wall, and it can be seen to disappear into the lower segment through the pelvic brim.

Fifteen roentgenograms; 2 photomicrographs.

WINSTON C. HOLMAN, M.D.
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THE GENITOURINARY SYSTEM

Severe Reaction Due to Intravenous Neo-iopax: Case Report. Carl K. Pearlman and John S. Newland. J. Urol. **68**: 407–411, July 1952.

A 36-year-old physician consulted the authors because of microscopic pyuria and hematuria. There was no history of allergy. Six years previously he had had excretory urographic studies without untoward reaction; it is not known what contrast medium was used at that time. For the present examination a preliminary conjunctival sensitivity test was negative; however, it was later discovered that Urokon was mistakenly used for the test. Twenty cubic centimeters of Neo-iopax was rapidly injected into the antecubital vein. When the injection was completed, the patient complained of warmth, of nausea, of "pins and needles" in the soles of the feet progressing upward, of headache, and of an urge to defecate. He soon passed into profound shock but never lost complete consciousness. He was placed in shock position and heat applied. Oxygen was given, epinephrine was administered intravenously and intramuscularly and an antihistamine intravenously. After twenty-five minutes the patient was transferred to the hospital, apparently unimproved. He was placed in an oxygen tent, a 5 per cent solution of glucose in physiologic saline (1,000 c.c.) containing one ampule of 1 to 1,000 solution of epinephrine was started, and 100 mg. of cortisone was given intramuscularly. About one and one-half hours after the Neo-iopax injection, and fifteen minutes after the infusion, the patient began to improve. He remained in the hospital for a day but was not well enough to return to work for four days.

After discussing the possible causes for such a reaction the authors recommend that an oral antihistaminic agent be administered at least one hour before the injection of the contrast medium at the time of the conjunctival test. Moderate reactions may be treated by subcutaneous administration of epinephrine. Severe reactions require intravenous administration of epinephrine, oxygen, and other measures to combat shock. Epinephrine is used in a 1 to 1,000 solution; 0.2 to 0.5 c.c. is given. Intravenous infusions of saline or glucose should be given to raise blood pressure above shock level. Administration of sympathomimetics giving sustained vasoconstriction is recommended. Cortisone may be of aid since such a severe reaction could produce temporary adrenal exhaustion. Antihistaminics tend to lower the blood pressure, and, since the damage due to histamine release has already taken place, their value once a reaction has occurred, isqu estionable; they are therefore not advocated.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Abdominal Aortography in Renal Diseases. A Preliminary Report. Rolf Weyde. Brit. J. Radiol. **25**: 353–359, July 1952.

The author has performed 210 aortographies in 200 patients for the diagnosis of renal disease without any deaths or serious complications. A simple technic,

using local anesthesia and a hand syringe for injection, is described. With the patient in the prone position, 30 c.c. of 70 per cent Diodrast is injected into the aorta through a long needle inserted below the twelfth rib, four fingers to the left of the spine. The first roentgenogram is taken just before the injection is completed. In each instance at least three exposures are made at short intervals in an attempt to get pictures of the arterial, capillary, and the venous phases of circulation. Aortography has been found useful in the diagnosis of solitary and multiple cysts, tumors, hydronephrosis and tuberculosis.

Aortography is contraindicated in the presence of severe renal disease, aortic calcification and aneurysm, and hypersensitivity to the contrast medium.

Twelve roentgenograms; 2 photographs.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Experiences with Percutaneous Trans-Femoral Renal Arteriography. Charles A. Hooks and Oliver H. Graves. South. M. J. **45**: 587–591, July 1952.

After carrying out percutaneous femoral artery catheterization on 50 unselected patients for renal arteriography, the authors are of the opinion that the procedure is relatively easy, safe, and offers satisfactory results in most instances. They feel it is more versatile than other methods and permits selective abdominal arteriography. Side-effects were found to be inconsequential. Urokon Sodium 70% and Neo-iopax 75 per cent are apparently safe contrast media, with Urokon giving better detail. Technic of the procedure, including puncture and catheterization of the femoral artery, is described only briefly, references being given to other published reports complete details.

Six roentgenograms.

WARREN A. NAFIS, M.D.
Jefferson Medical College

Effect of Enemata on Contrast Excretion in Urography. Ragnar Steinert. Acta radiol. **38**: 30–32, July 1952.

Enemas given prior to intravenous urography are generally considered to cause dilution of the contrast medium after absorption from the colon. Fifteen patients were subjected to urography after being kept twelve hours without fluids. A 2-liter enema was administered on the day of examination and the return measured after filtering through gauze. A half-hour later a second 2-liter enema was given, and the return measured in a similar manner. Forty-five minutes to one hour elapsed before both enemas had passed, and the patient was ready for urography.

The total retention of the two enemas ranged from 425 to 1,550 ml. in 15 patients, of which 200 to 650 ml. were accounted for by the first enema.

Satisfactory concentration of the contrast medium was obtained in both renal pelves in 14 patients. Three patients who retained 1,000, 1,500, and 1,400 ml., respectively, showed good filling. Seven additional patients received only one preparatory enema, and in 3 of these the examination was unsuccessful. In 3 of the 4 unsuccessful cases (in a total of 22) the contrast was satisfactory on one side but unsatisfactory on the other.

The author concludes that cleaning enemas are essential in the preparation for intravenous urography provided the examination can be completed within one hour.

One roentgenogram.

I. R. BERGER, M.D.
VA Hospital, Atlanta Ga.

The Clinical Significance of Reflux in Retrograde Pyelography. G. Möckel and E. Krasemann. Radiologia Clin. **21**: 20–33, January 1952. (In German)

Since the introduction of retrograde pyelography a number of papers have been written concerning the reflux of the opaque medium. The tubular reflux is caused by a passage of the contrast medium into the canaliculi. According to Fuchs it is most commonly seen in dogs. In cases of destruction of the calyceal wall the medium enters the perivascular spaces and the sinuses, leading to a pyelovascular backflow and subsequently to a pyelovenous backflow. Similarly, a pyelolymphatic backflow might occur.

The main causes for reflux are:

1. Non-physiological high pressure in the pelvis and calyces due to (*a*) high pressure during injection, or (*b*) pathological peristalsis in inflammatory conditions or a disturbance in the urinary flow in the ureters.
2. Damage to the wall of the pelvis and calyces caused by surgical interference or due to diseases like tuberculosis, pyelonephritis, hydronephrosis, tumors, or stones.

The electrochemical and colloidal relationship between the contrast medium and the membranes are also of great importance. Hinman and Redewill (1926) found that in patients with an alkaline urine there was a greater tendency to reflux than in those with acid urine.

The important clinical sign of backflow is a sudden onset of persistent pain in the region of the kidney. Cases have been reported in which a marked fall in blood pressure occurred, with collapse and chills. When infected kidneys are injected and a backflow occurs, a bacteriemia and urosepsis may ensue.

The volume of injected contrast medium should vary between 6 to 12 c.c.; Braasch states that even 20 c.c. is within normal limits. Some authors found experimentally that with a pressure of 20 to 40 mm. Hg no reflux occurred, whereas with a pressure of 60 to 70 mm. Hg a reflux took place. Taterka (1927) felt that if a reflux occurred when a normal pressure was exerted, some pathological inflammatory conditions of the kidney existed. The latest reports by Lowsley and Kirvin (1944) and Eisendrath (1930) state that a pressure up to 60 mm. Hg is permissible. In the literature the incidence of reflux is reported as being about 10 per cent and even as high as 25 per cent. According to Fuchs, 70 per cent of the backflow is pyelovascular, 15 per cent is due to sinus extravasation, and 15 per cent represents a subcapsular extravasation.

The authors built a unit with a manometer to measure the pressure of the injection. After experimental work they discovered that the pressure on the manometer should be about 130 mm. Hg, which would correspond to a pressure of 30 to 35 mm. Hg in the kidneys. The best results were achieved with an injection of about 8 to 9 c.c. in ninety to one hundred and twenty seconds. This holds for kidneys with calyces and pelvis of normal sizes, and the figures should be varied in small kidneys or in cases of pyelectasia. The authors performed retrograde pyelography in 120 patients (92 females, 28 males). Reflux occurred in 5.7 per cent of the cases, which is a low figure compared with the incidence given in the literature. They conclude that even under controlled retrograde injection some extravasations occur as hyperperistalsis is sometimes present in pathological conditions, and this might lead to a reflux. They feel

that injections under manometric control are of value.

Four roentgenograms; 1 photograph.

JULIAN O. SALIK, M.D.
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Congenital Solitary Kidney. Vincent J. Longo and Gershom J. Thompson. J. Urol. **68**: 63–68, July 1952.

Congenital solitary kidney is found in about 1 of every 1,000 cases in which necropsy is performed and in clinical practice it is found in approximately 1 of every 1,500 cases. The anomaly does not have a tendency to occur more frequently on either side nor does it favor either sex. Solitary kidney is associated with complications and other anomalies more frequently in females, and therefore in clinical practice the anomaly is found more frequently in females. It is usually discovered when the patients are between the ages of thirty-five and forty-five years of age.

In one-third of a group of 69 cases of congenital solitary kidney previously reported (Braasch and Merricks: Surg., Gynec. & Obst. **67**: 281, 1938), active pyelonephritis was present at the time of examination or had been present previously. There was an associated anomaly of the kidney in 7 cases, hydronephrosis in 6 cases, and calculi in the renal pelvis or ureter in 6 cases. Nephritis and renal tuberculosis occur more frequently in patients who have a congenital solitary kidney than they do in normal persons. Genital anomalies are also associated more frequently with a congenital solitary kidney than with any other type of renal malformation. This is particularly true in females.

The present study is based on 94 cases of congenital solitary kidney observed at the Mayo Clinic in a period of twelve years, from 1938 to 1949. Fifty-seven patients were males and 37 females, the sex distribution differing from that in previous series. The average age was thirty-seven years. The left kidney was absent in 51 cases, and the right kidney was absent in 43. Pain, usually on the side of the solitary kidney, was the most common symptom for which the patient sought medical advice. Associated congenital anomalies were present in 37 of the cases. The incidence of associated genital anomalies was slightly higher in females than in males. Urolithiasis was the most common complication, occurring in 12 cases. The solitary kidney was ectopic in 5 cases. In 8 of 69 satisfactory pyelograms the outline of the psoas muscle was obscured on the side of the absent kidney. In 13 of 75 cases in which cystoscopy was performed, both ureteral orifices were present but there was a blind ureteral lumen at or near the ureterovesical junction on one side. In 37 cases there was absence of one ureteral orifice and the corresponding half of the interureteral ridge or trigone. In a third of the cases the ureteral orifice was absent but the interureteral ridge and trigone appeared to be normal.

Five tables.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Bilateral Polycystic Kidney Disease. Review of Ninety-Four Cases. Charles C. Higgins. Arch. Surg. **65**: 318–329, August 1952.

Bilateral congenital polycystic kidney disease has been justly called "the most important malformation of the urinary tract." A review of the literature of the last twenty years reveals that approximately 75 per cent of the cases are not detected or recognized clinically, and an accurate diagnosis is not established until postmortem examination.

Polycystic kidney disease is a massive involvement of the renal parenchyma by cysts varying in number and size. The condition is congenital in nature, is probably always bilateral, and pursues a slow but progressive course. It follows Mendel's laws of inheritance and may be transmitted equally by either sex.

Ninety-four cases of congenital polycystic kidney disease were observed at the Cleveland Clinic between 1935 and 1951. The clinical incidence is approximately 1 to 4,000 cases; the actual incidence is probably 1 to 500 or 1 to 750 births. The average age at which diagnosis was established was 43.8 years; the youngest patient was twenty-three years of age, the oldest sixty-two. Macroscopic hematuria was present in 39 patients (41 per cent), and abdominal pain was experienced in 61 cases (64 per cent). Bilateral renal enlargement was found in 52 cases (55 per cent), unilateral in 24 (25%), and no enlargement to palpation occurred in 15. Hypertension was present in 69 cases (73 per cent).

Blood urea values above 40 mg. per 100 c.c. occurred in 70 per cent of the cases in the present series.

The roentgenographic diagnosis polycystic kidney disease may be extremely difficult early in the course of the disease. When the cysts are small, renal enlargement may not be discernible and the pelves are practically normal in size and shape. As the cysts increase in number and size, the kidney shadow is enlarged visually and the pelvis becomes enlarged and distorted. The calyces are deformed, angulated, and elongated. Later the typical "dragon deformity" results. Unquestionably the most important diagnostic feature is the bilaterality of the deformity in polycystic kidneys. Intravenous urograms proved diagnostic in 33 of 65 studies, and a tentative diagnosis was made in 17 additional cases. Retrograde pyelography was performed in 56 cases and proved diagnostic in 56 cases.

General operative procedures and surgery confined to the urinary tract are frequently required. Medical treatment is advocated in the majority of cases of polycystic kidney disease.

Four roentgenograms.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Simple Renal Cysts. S. Glaser. Brit. J. Surg. **40**: 74–78, July 1952.

Five cases of renal cyst are reported. The main problem presented is differentiation from tumor. Radiographic signs in both are a rounded soft-tissue mass of homogeneous density; compression and flattening or stretching of the calyces and pelvis, or distention and clubbing. Once these pyelographic abnormalities have been demonstrated, the only reliable differential method is in surgical exposure.

The etiology of simple cysts is uncertain. They are usually unilateral, cortical, and polar. They may be single or multiple and contain fluid which is not urine. Symptoms are not pathognomonic.

The author advises simple excision except for hemorrhagic cysts. Since the latter are likely to be malignant, nephrectomy is the procedure of choice.

Seven radiographs; 1 drawing; 1 table.

MARSHALL B. TUCKER, M.D.
Oakland, Calif.

Renal Ossification: Report of Occurrence in an Aplastic Kidney. C. George Tedeschi and William H. Holtham. J. Urol. **68**: 50–59, July 1952.

Since metaplastic ossification has been described in

diverse locations and under a variety of experimental conditions it may be inferred that connective tissue, as a whole, has latent osteogenic potencies and that periosteum and perichondria merely exhibit to a special degree this universal transformability of the fibroblast. Experimentally, metaplastic ossification is readily produced in the urinary tract. Spontaneous formation of bone in the urinary tract, however, is a rare condition.

The authors report the case of a 25-year-old woman initially studied because of urinary frequency and dysuria. A large circular, calcified shadow and a subjacent, smaller, rounded shadow were present in the left upper quadrant. No medium was excreted from the left kidney. The symptoms were thought due to cystitis and right pyelonephritis. The left ureter could be catheterized for 8 cm., but no urinary drainage was obtained from that side and no contrast material was seen in the ureterogram beyond the tip of the catheter. Left nephrectomy was done. No ureter could be identified to a distance of 15 cm. below the kidney.

The removed specimen was a bean-shaped, shell-like formation, 8.5 cm. long and 5.4 cm. in width at its largest portion. The outer aspect was smooth and pale gray in color. It was found to be a single cyst containing grayish-yellow fluid. A small, irregularly rounded, ossified cystic mass was connected to the lower pole of the cyst by a fibrous band. Lime deposits were present in the wall of the large cyst; independent from these deposits spongy bone was noticeable in broad areas. This consisted of irregular plates and bars of various thickness which branched and united with each other. Numerous osteocytes were imbedded in the interstitial bone substance and regularly aligned osteoblasts were present at the edges of the bony plates. No differentiated renal elements or structures could be seen in the larger cystic mass, but a few embryonal renal tubules were present in the smaller cyst. No glomeruli were seen.

Since the term "renal aplasia" is used to indicate an incompletely or defectively developed kidney without a functioning drainage system, the present case represents an aplastic kidney. The authors discuss the pathogenesis of renal aplasia and of metaplastic ossification. A few similar cases previously reported are reviewed and analyzed.

Two roentgenograms; 1 photograph; 2 photomicrographs.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Les Contusions du Rein. (Contusions of the Kidney.) L. Sabadini and J. Ducassou. 107 pages. Masson et Cie, 120, boulevard Saint-Germain, Paris, 1952.

Renal contusions may occur as isolated lesions or in conjunction with injuries to the liver or spleen. These two main groups are discussed separately in the present monograph.

Isolated renal trauma may lead to intrarenal rupture, extrarenal rupture, or to gross lacerations of the kidney. Hydronephrotic kidneys are more susceptible to injury. At times the posterior parietal peritoneal membrane may be ruptured. Most renal contusions are accompanied by hematuria, unless the renal pedicle is ruptured. Clinical considerations are presented. Injury to the lower urinary tract and fracture of the pelvis should be ascertained.

Plain roentgenograms and intravenous urograms give considerable information in assessing the extent of renal damage. Distortion, leakage from the renal pelvis, and even complete suppression of opaque excretion may be noted. Pyelocalyceal amputation and intrapelvic blood clots may be demonstrated. Intravenous urography is also of considerable aid in following the course of the patient under therapy. Roentgenograms of the lower thorax may reveal splinting of the diaphragm.

Treatment of renal contusions may be conservative; sometimes simple renal repair is indicated and, rarely, nephrectomy may be required. Sequelae are usually not severe. Continued hematuria may occur. Renal contusions seldom lead to hydronephrosis or calculus formation.

Sixty-five illustrations.

CHARLES M. NICE, M.D.
University of Minnesota

Urinary Calcification Associated with Nephrocalcinosis. William J. Engel. J. Urol. **68:** 105–116, July 1952.

In an earlier report (J.A.M.A. **145:** 288, 1951. Abst. in Radiology **58:** 153, 1952) the author reviewed 7 cases of nephrocalcinosis, 5 having stones. He now reports 5 additional cases, all associated with calculus formation.

Nephrocalcinosis may result from abnormally high concentrations of calcium or phosphorus in the blood, resulting in precipitation of calcium phosphate in normal tissue (*i.e.*, hyperparathyroidism) or from local tissue damage with precipitation of calcium in the presence of normal blood levels (*e.g.*, infections, bacterial toxins, and various chemical agents causing damage to renal cells). The experimental and clinical features of nephrocalcinosis and the relationship between nephrocalcinosis and calculi are discussed.

Histories of the 5 new cases of nephrocalcinosis are given and the roentgenograms reproduced. In 2 cases the nephrocalcinosis was unilateral. All patients had stones; in some cases the discovery of nephrocalcinosis was made only because the patient sought medical care for renal colic. After reviewing these and the previous 7 cases the author concludes that we are justified in assuming that the primary trouble is renal tubular disease brought on by some nephrotoxic agent, either bacterial or chemical. The calcification follows this tissue damage, occurring chiefly in the distal and collecting tubules and extratubular tissue of the renal papilla. This tubular dysfunction may lead to metabolic disturbances, notably hyperchloremic acidosis and disturbances in calcium and phosphorus metabolism. Urinary calculi are the result of the tubular and papillary calcifications. Nephrocalcinosis may be unilateral or localized in a small portion of the kidney.

The author quotes Randall as concluding that in the absence of stasis it is a pathologic condition of the renal papilla which leads to primary renal calculus formation. Calcium salts are deposited in an attempt to repair damaged collecting tubules and supporting interstitial tissue. Two types of renal papilla lesions have been observed. Type 1 is a predominantly interstitial calcium plaque, usually situated at the pyramid apex. It is usually on the side wall of the papilla and remains harmless until brought to the surface by growth and pressure. After exposure it is bathed in urine and becomes a nidus upon which any urinary salt may crystallize. Type 2 is predominantly an intratubular calcification, causing tubular damage. Only calcium phosphate is demonstrated in this type, and any stone formation

occurs at the papillary tip where the pathologic process is most advanced.

Thirteen roentgenograms.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Triplication of the Ureter and Renal Pelvis. Richard D. Gill. J. Urol. **68**: 140–147, July 1952.

The author reports a case with three kidney pelves and three ureters on one side and two kidney pelves and two ureters on the opposite side.

The embryology and the events leading up to the urinary anomaly are discussed as is the frequency of ureteral anomalies. Ureteral triplication is classified as follows: (1) triple ureter, in which there are three separate and distinct ureters opening into the bladder or elsewhere; (2) double ureter with one bifid, in which two ureters may unite, leaving only two orifices; (3) trifid ureter, in which all three ureters unite and drain through a single orifice; (4) double, with inversion Y bifurcation and resulting three orifices. Including the case presented by the author there have been 13 cases of ureteral triplication and 7 cases of trifid ureter reported. A number of line drawings clearly illustrate the types of triplicate ureter.

The author's patient was a 31-year-old woman who complained of right lower quadrant pain of several months duration. The urine was alkaline and loaded with pus. At cystoscopy two ureteral orifices were noted on the left. On the right side there was one orifice which was larger than normal and gaped in a peculiar manner. Retrograde pyelography revealed an impacted, rather large, ureteral calculus on the right and two large atypical renal pelves with two hydro-ureters which apparently united above the stone. A ureterotomy was done and the stone removed; the patient made a good recovery. Follow-up studies revealed a shadow in the region of the upper pole of the right kidney above the two pelves which had not been present previously. Excretory urography proved this to be renal tissue, but a third ureter could not be identified after repeated search. Three fairly large stones, all apparently from this upper pelvis, developed and they moved up and down the ureter freely. The patient began having further attacks of severe pain and consented to another operation. It was found that the three pelves were contained in one capsule; there was no communication between them. Three ureters led from the pelves, the two lateral ones uniting about half way down, running from this point to the bladder in one sheath. The third ureter ran separately to the bladder wall, uniting with the other intramurally.

Seven roentgenograms; 5 drawings.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Congenital Multilocular Bladder: A Case Report. Fedor L. Senger and Vincent J. Santare. J. Urol. **68**: 283–288, July 1952.

Congenital bladder divisions are frequently seen in clinical urology. The classification proposed by the author is as follows:

A. Saggittal or Longitudinal Divisions
   1. Complete reduplication of the bladder
   2. Incomplete reduplication of the bladder (vesico-bipartite)
   3. Complete sagittal septum (vesico-duplex)
   4. Incomplete sagittal septum

B. Frontal or Transverse Divisions
   1. Complete frontal septum
   2. Incomplete frontal septum
   3. Hour-glass bladder

C. Multilocular Bladders

Diverticula are differentiated from bladder divisions by a number of criteria and these are enumerated.

Sagittal divisions of the bladder form 2 bladders or partitions of one by a septum which divides the organ into right and left sections. Bladder reduplication results from complete splitting of the bladder anlage. In 10 cases of complete reduplication there was reduplication of other cloacal organs as well. There are 2 separate and distinct bladders, each with a urethral crifice. In incomplete reduplication there are 2 compartments separated by an indentation in the external bladder contour and not only septal separation. A complete sagittal septum divides the bladder into two chambers with no change in external configuration. The septum is considered incomplete if it has an opening.

Frontal divisions of the bladder are less frequent. This group includes hour-glass bladders in which the transverse septa are found only in the posterior portion of the bladder. Only 1 case of complete frontal septum has been reported. Congenital multilocular bladders have associated ureteral obstruction. The loculus always contains a ureter; its posterior portion is normal bladder wall.

The case reported is that of a 16-year-old girl with lower abdominal pain, fever, pyuria, and dysuria. Laboratory studies showed impaired renal function. Cystoscopy revealed a large dilated bladder with dilated ureteral orifices on both sides. A septum extended from the interureteric ridge around the sides of the bladder to the internal urethral orifice. A small perforation was seen in the septum. Retrograde pyelography demonstrated bilateral hydroureter and hydronephrosis. There was complete reduplication of the right kidney and ureter. It was deduced that this was a bilocular bladder with complete right kidney reduplication. The ureter from the lower pole of the right kidney and the left ureter emptied into the bladder above the septum. The orifice of the ureter from the right upper kidney was below the septum. This was confirmed at cystostomy, at which time the septum was excised forming one bladder cavity. The septum consisted of connective tissue lined on both sides by squamous and transitional epithelium; no smooth muscle was found.

One roentgenogram; 7 drawings.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Urethrocystography. Edward A. Waldron. J. Fac. Radiologists **4**: 54–63, July 1952.

The writer has undertaken the investigation of a series of genitourinary cases by urethrocystography in order to determine: (1) the practicability of routine, complete urethrocystography in a busy department; (2) the types of lesions which can be demonstrated; (3) the indications for urethrocystography.

The paper includes a review of the literature, a description of a modified instrument and of the technic used. Initially one hour was allocated for the exami-

nation, but it is now completed in thirty minutes. Local anesthesia has not been found necessary. Three radiographs are taken during injection of the contrast medium, two while the patient voids, and one after the bladder has been emptied.

No complications arose in the author's series of 61 cases. Indications for urethrocystography include post-prostatectomy states, urethral structure, diverticula of the bladder, and diverticula of the urethra. Contraindications to the procedure are recent instrumentation, bleeding from the lower urinary tract and acute local infection. In the assessment of results, the author considered the examination diagnostic in 51 of his cases and helpful in 10.

Eleven roentgenograms; 2 photographs.

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PNEUMORETROPERITONEUM

A New Technic in Roentgen Diagnosis: Pneumoretroperitoneum. C. Buetti-Bäuml. Radiol. clin. **21:** 225–242, July 1952. (In German)

The term pneumoretroperitoneum is preferred to that of retropneumoperitoneum, under which the procedure was introduced by Ruiz-Rivas, because of etymologic correctness. The procedure consists of the introduction of air or gas into the common retroperitoneal fascial space, usually into its caudal extension immediately anterior to the sacro-coccygeal joint. Its popularity is justified by its simplicity, harmlessness, and diagnostic possibilities. It is the only current method for demonstration of the adrenal glands. Scout films are of value solely in cases of massive, dense tumors or calcification. A few years ago direct perirenal insufflation enjoyed popularity until its inadequacies, such as the necessity of two punctures, the danger of air embolism, and the difficulty of determining the stopping point of the needle, forced its abandonment. Pneumoretroperitoneum has also supplanted the perirenal route for the delineation of the external renal contour. While intravenous urography, retrograde urography, and aortography demonstrate various phases of internal renal structure, pneumoretroperitoneum alone outlines the organ itself.

Buetti-Bäuml follows the accepted technic for the procedure. After the intestinal tract has been cleansed with cathartics and enemas and after the administration of a barbiturate for light sedation, the patient is placed on the x-ray table in the knee-chest position. A lumbar puncture type of needle is inserted between the anus and the coccyx, using a gloved finger in the rectum as a guide, so that the tip lies 1 cm. anterior to the sacrococcygeal joint and at a total depth of penetration of 5 cm. With a pneumothorax machine providing a pressure of 60 to 80 mm. of Hg, 1 to 2 liters (average, 1,400 c.c.) of oxygen is injected over a period of fifteen minutes. The patient then sits upright for one or two hours, following which roentgenograms are taken. The author prefers tomograms at levels of 5 to 9 cm. with the patient supine. [In the abstractor's experience the best films are stereoscopic postero-anterior views with the patient prone and the table horizontal.—W.F.W.] With this technic there have been no true accidents and few failures in countless cases.

Four cases are presented and illustrated: a 40-year-old woman with a pheochromocytoma, an adolescent girl showing diffuse adrenal hyperplasia associated with pubertas praecox, a normal patient and one with a left hydronephrosis.

Seven roentgenograms; 1 drawing; 1 photograph.

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Royal Oak, Mich.

Diagnostic Subserous Emphysema. F. Sommer and K. Reinhardt. Fortschr. a. d. Geb. d. Röntgenstrahlen **77:** 54–62, July 1952. (In German)

Of all the various diagnostic procedures utilizing the injection of air for the visualization of the abdominal or retroperitoneal organs, the one described by Ruiz-Rivas, in 1947, gives by far the most information and entails the least danger for the patient. The procedure consists of the injection of air below the coccyx into the loose presacral fatty tissue. From there the air infiltrates the entire retroperitoneal space, traveling easily into the loose connective tissues around the kidneys. It may go through the root of the mesentery into the mesentery itself and may surround with a thin layer the bowel itself, particularly in the region of the cecum and of the sigmoid. It may travel upward through the diaphragmatic hiatus into the mediastinum and allow the visualization of some of the organs there. In the pelvis it goes into the parametrium and permits a visualization of the uterus, the tubes, the round ligaments, and the ovaries.

The authors have obtained uniformly satisfactory results without any disagreeable or dangerous side-effects with the following technic: Nothing is given by mouth for twelve hours prior to the examination, and the bowels are cleansed with a cathartic. The patient kneels on the table, with the upper part of the body bent forward and supported upon the table with the elbows. No anesthetic is necessary. The ony instruments used are a needle, a 200 c.c. syringe, and a thin rubber hose connecting the two. The needle is inserted below the coccyx into the loose presacral tissue. Using a moderate amount of pressure, 1,000 to 1,600 c.c. of air or of oxygen are injected. Before the injection, the piston is pulled back to make sure that no blood vessel has been pierced. It has happened that the rectum was accidentally pierced, but no dangerous sequelae followed.

In the authors' experience, the ordinary roentgenogram has not proved satisfactory. Valuable information, however, has been obtained by body section roentgenography. Both kidneys can be demonstrated easily, and their size, shape, and location can be plainly determined. The adrenals which appear as crescent-shaped or triangular shadows above the kidneys can be easily seen on tomograms, particularly if the films are taken in the standing position (this position lowers the kidneys and allows more air to go into the space above them).

For the visualization of the pelvic organs in women, only 600 c.c. of air is used. While the patient is still on the table in the knee-chest position, she is instructed to compress her abdominal muscles several times (Valsalva maneuver). This forces more air into the loose connective tissue of the parametrium.

The stomach and colon can be visualized quite well if air is introduced into the stomach and into the colon as well as into the retroperitoneal space. The pancreas cannot be well seen on the anteroposterior view. It can be demonstrated quite satisfactorily, however, in many cases if tomograms are taken in the lateral position. By varying the distance of the section, the head, the body, and the tail can often be visualized.

The authors have been able to demonstrate the thymus, the pulmonary arteries, the aorta, etc., in lateral tomographic views.

Very instructive and valuable information may be obtained if retropneumoperitoneum is combined with intravenous pyelography or, for the visualization of the pelvic organs, with hysterosalpingography.

The authors report an interesting therapeutic value of the procedure. Some of the urologists state the peeling out of organs and the finding of the proper layers during urological operations was considerable facilitated by a previous retropneumoperitoneum.

Eleven roentgenograms; 1 drawing.

WM. A. MARSHALL, M.D.
Chicago, Ill.

Le Pneumo-Rétro-Péritoine. (Pneumoretroperitoneum). L. de Gennes, J.-P. May, and J. Hélie. 105 pages. Masson et Cie, 120, boulevard Saint-Germain, Paris, 1952.

This monograph gives the technic, indications, advantages, and results of pneumoretroperitoneum based on 345 studies by the authors. A long needle is used to pierce the anococcygeal raphe and penetrate the retrorectal space. Oxygen is preferred as a contrast agent, in amounts of 400–600 c.c. in children up to 1,000–1,200 c.c. in adults. The bowel is cleansed as for urography. A delay of one-half to one hour before x-ray studies is advised. After four hours the image is less clear. A good outline of the kidneys, spleen, and liver is usually obtained. Tomography is useful in studying the adrenals.

The authors have had no deaths in their series. They have a report of a death in one patient with Addison's disease. Occasionally pneumomediastinum is seen. No cases of infection have been encountered. Pneumoperitoneum requires injection of more gas, up to 2,000 c.c., and is more often followed by complications such as hemorrhage and gaseous embolism.

In the normal patient a good outline of the psoas muscles, diaphragm, kidneys, liver, and spleen may be obtained. The normal pancreas is not well delineated, but when masses are present it may be seen. Errors of interpretation may be due to rib margins and abdominal folds; the fluid-filled gastric fundus may simulate a tumor.

Tumors, enlargements, and perinephritic infections of the kidneys may be demonstrated. Tumors of the adrenals, pancreas, splenic, and hepatic enlargements, other intra-abdominal tumors and perivisceritis may be delineated.

The method is considered an important diagnostic procedure.

Fifty-five roentgenograms.

CHARLES M. NICE, M.D.
University of Minnesota

CONTRAST MEDIA

Iodism. Thomas M. Irwin. Ann. Otol., Rhin., & Laryng. 61: 408–434, June 1952.

The author discusses idiosyncrasies to iodinated compounds resulting in iodism. In general, iodism is manifested by acneform, maculopapular, vegetative (including frambesiform, fungating and granulomatous), vesicular, or bullous eruptions; coryza, conjunctivitis, bronchial irritation, and general swelling and inflammation of the mucous membranes; vascular symptoms such as edema, including angioneurotic edema, erythema, purpura, and erythema multiforme, which may affect the skin and mucous membranes; fever and nervous irritability.

A fatal case of severe acute iodism in a 62-year-old white woman, with autopsy, is reported in detail. Iodochlorol in this case was employed in the course of a bronchoscopic examination. No history of asthma, hay fever, urticaria, or other allergy was present. It illustrates well most of the complications which are known to occur, including edema of the glottis, iododerma, and exacerbation of chronic glomerulonephritis.

This single case with its extreme manifestations and fatal termination serves to emphasize the risk involved in the occasional case, particularly in the presence of renal damage.

The use of iodinated compounds may be contraindicated in bronchography and other diagnostic procedures, as well as therapeutically, when pre-existing renal involvement is present.

Two photographs.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

MICRORADIOGRAPHY

Mass, Lipids, Pentose Nucleoproteins, and Proteins Determined in Nerve Cells by X-Ray Microradiography. Sven-Olof Brattgård and Holger Hydén. Acta radiol. Suppl. 94, 1952.

The authors describe an original and very ingenious application of microradiography to the determination of cell mass and certain components of cells, namely lipids, pentose nucleoproteins (P.N.P.), and protein. The procedure is based on the theory that the mass of biological material with regard to the main components of cells (C, N, and O) is proportional to the absorption of x-radiation in the wave-length region of 8–10 Å.

The microradiographs were made with the method of Engström and Lindström. A water-cooled, pump-evacuated tube was used at 3 kv., 15–30 ma., 9 μ Al filtration, with exposure times of one to two minutes. The exposures were made on Lippman emulsion, which was processed in a special developing solution. The sections studied were 3–10 μ thick.

Microradiographs of fresh-frozen single nerve cells were analyzed for density by a microphotometer, and by comparing the results with a reference system of nitrocellulose film, cell mass could be determined. The nerve cell and the reference system were exposed on the same film. The weight of the cell and the various fractions were expressed in 10^{-9} mg./μ^3. The specimen was then subjected to the extraction of lipids by chloroform, and another microradiograph was made. The difference in weight from the original cell was attributed to the lipid fraction. Following this procedure the cell was subjected to enzyme digestion by ribonuclease, and by means of a microradiograph, the weight of the P.N.P. fraction was determined. The remaining cell weight was calculated to be due to cell proteins. The analysis of the various fractions of the cell was carried out in the same area of the nerve cell.

The chemical composition of the various nerve cells differed quantitatively with respect to the fractions studied. The cells of Dieter's nucleus contained large amounts of lipids and P.N.P. The P.N.P. and lipid fraction of spinal ganglion cells were small. Three types of Purkinje cells were found.

Microradiographs of excellent quality are shown up to $\times 1150$ in the various stages of the weight determination.

The resolving power of the method lies at 4 μ^2. With regard to sources of error, the authors concluded that in a single x-ray determination the possible error amounts to ±3.5 per cent.

The use of x-ray in quantitative chemical analysis of nerve cells should be of interest to radiologists, especially those who are following the development of microradiography. This relatively young but important branch of radiology will certainly find wide application in medicine in the future.

WALLACE S. TIRMAN, M.D.
Bluffton, Ind.

RADIOTHERAPY

An Assessment of the Palliation of Advanced Cancer Obtained by Simple Radiotherapeutic Methods. Margaret C. Tod. J. Fac. Radiologists **4**: 28–43, July 1952.

One of the principles upon which the radiotherapy of cancer should be founded is that it is necessary before beginning treatment to decide whether the aim is cure or palliation.

The criteria of palliation are discussed. Case histories and questionnaires have been analyzed, using certain conventions: (1) All patients dead within two months have been regarded as failures. (2) Patients who lived for more than two months and less than twelve were divided into three classes: those who had no palliation, those who had some palliation, and those who had good palliation. (3) All patients who lived more than twelve months were regarded as having had palliation.

The criteria used for assessing palliation were as follows: *No palliation:* There was either a complete failure to relieve symptoms or temporary relief was followed by a relatively long period of painful or distressing illness. *Some palliation:* There was a period of satisfactory relief of symptoms at least as long as the subsequent painful or distressing illness. *Good palliation:* There was a period of complete or almost complete relief of symptoms followed by a terminal illness short in relation to the period of relief.

The material used in the investigation was derived from a study of carcinoma in common sites treated between 1940 and 1948. All the patients in this survey received x-ray therapy except those with cancer of the cervix treated by intracavitary application of radium. The seven sites where cancer is commonly treated for palliation are the mouth, pharynx and larynx, esophagus, lung, breast, uterine cervix, and bladder. The technic of palliative treatment of cancer at each location is taken up separately. The author admits that it is not easy to follow a thread of thought through a series of commentaries on the different conditions, and she therefore summarizes the results of treatment in a single table. All cancers except those of the urinary bladder are placed in two groups: those treated by a dose below three-quarters of the radical percentage and those treated by above three-quarters of the radical percentage. In cancer of the bladder the dividing point for dosage has been taken as two-thirds of the radical percentage.

The author also stresses that when we try to palliate we are not concerned with giving "just a little x-ray therapy," the dose being unimportant because the treatment is bound to do some good, but with the need to decide on the correct dose and deliver it. The optimum duration of treatment cannot be deduced from the evidence available, although at the author's hospital palliative treatment does not occupy a longer period of time than from one to nine days. Palliation is difficult to obtain and measure, but its part in cancer treatment is so important there is need to extend its scope by improving the purely palliative technics.

A. W. BROWN, M.D.
Charity Hospital, Shreveport, La.

Range and Ionizaton Density of Electrons Released Through Roentgen Irradiation. F. Wachsmann. Strahlentherapie **89**: 128–136, 1952. (In German)

The author describes an ionization chamber which can be adjusted to different depths and which permits a study of the range of electrons liberated in bone by x-rays from 20 to 200 kv. The values found in his investigation are in good agreement with the calculations of Lea as, within the above voltage range, only a slight variation in the velocity of the electrons was found. The values measured for the average electron range in water, however, are 1 to 2 μ only, thus being by a factor of 3 to 5 lower than Lea's calculated values. This is explained by the disposal of the angles and by the fact that Lea did not sufficiently take into account the detour factor.

ULRICH K. HENSCHKE, M.D.
Ohio State University

Short-Time Radium Treatment. Osolando J. Machado. J. Fac. Radiologists **4**: 73–76, July 1952.

The author has been investigating the possibility of using radium applicators or implants of high intensity in r per hour to reduce the time required for the treatment of cancer from that necessary with the classical curietherapeutic technic.

Results of this investigation show that the evolutionary cycle of reaction is in accord with the dose in the specific time and is in no way connected with the personal element factor.

The results with radium implants were identical with those obtained with radium contact.

The author calls attention to the large dose of irradiation to the hands of the radiotherapist during the implantation of the needles whose charge is about seven times greater than those commonly used.

Fifty-six patients with skin cancer of the face have been treated by the short-time radium technic. Best results were obtained when 2,500 r were delivered in eight hours. The radio-epidermite was only noticeable about the fifteenth day after treatment with total healing about the fortieth day.

An important advantage of the short-time radium technic is the lessening of suffering for certain patients.

Twenty-two photographs.

WINSTON C. HOLMAN, M.D.
Charity Hospital, Shreveport, La.

Roentgen Therapy in Pituitary Adenomas, With Special Consideration of the Chromophobe Type. H. M Aitken and E. A. Pohle. Wisconsin M. J. **51**: 666–671, July 1952.

Thirty-six patients having pituitary tumors were seen

at the Wisconsin General Hospital between 1936 and 1951. In 14 cases there was histologic proof of the presence of tumor obtained either from a biopsy or postmortem specimen. Three of these cases were treated by operation only and 11 by x-rays plus operation. Twenty-two cases were diagnosed on the basis of the clinical and x-ray findings. Of these 17 received roentgen therapy; 5 patients were untreated.

The anatomy, physiology, and pathology of the pituitary body are briefly discussed, and a simple classification of pituitary tumors is presented.

1. Adenomas
   - A. Chromophobe adenomas: Symptoms from pressure
   - B. Basophilic adenomas: Symptoms mainly those of metabolic and gonadal dysfunction
   - C. Eosinophilic adenomas: Symptoms of growth disturbance
2. Craniopharyngiomas: Symptoms of intrasellar or suprasellar pressure. Frequent calcification
3. Miscellaneous (Fibromas, angiomas, chordomas, teratomas)

The technic for roentgen treatment is outlined and consists in the use of x-rays generated at 175 kv., half-value layer 1.05 mm. Cu. The tumor area is cross-fired through one frontal and two temporal fields measuring 4 × 4 cm. or 6 × 6 cm., with a target-skin distance of 50 cm. Ordinarily 100 to 200 r (air) is given to each field daily until a total tumor dose of between 2,000 and 3,000 r has been delivered. The first two or three treatments are given cautiously to avoid sudden increased intracranial pressure. Visual fields are checked frequently, and any pronounced contraction is an indication to suspend or reduce treatment. If field contraction persists or increases, immediate surgical intervention is called for.

There is a moderately detailed discussion of those patients receiving roentgen therapy in this series. It is felt that irradiation has a definite place in the treatment of pituitary tumors, especially postoperatively when there has been incomplete removal of the tumor. It may be indicated in some cases as a single therapeutic agent.

The authors believe that not all chromophobe adenomas are highly radioresistant. Satisfactory response may be expected provided sufficiently high doses are administered. Only one basophilic tumor was treated in the series. Diagnosis in this case was questionable, and the patient's condition was not improved. The adrenals may have been the primary site of disease; if so, it might be worthwhile in such cases to consider irradiation of the adrenals. Acidophilic adenomas on the whole did not show a consistent response to treatment.

Eleven tables; 1 diagram.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Carcinoma of the Tongue. A Study of the Cases Treated at the University Hospitals, Iowa City, Iowa, Between the Years 1930 and 1944. H. B. Elkins. Am. J. Roentgenol. **68**: 81–88, July 1952.

A review of the 98 consecutive cases of carcinoma of the tongue treated at the University Hospitals, Iowa City, Iowa, between 1930 and 1944 is presented. Males predominated in the series (78.6 per cent). The average was 63.8 years; the youngest patient was thirty-five and the oldest eighty-seven. Syphilis was present in 24.5 per cent of the cases. Of the 24 patients with syphilis, only 2 survived five years and one of these developed a new cancer of the tongue six years after treatment.

The most frequent complaint was a "sore" (ulcer) on the tongue. This was the main complaint in 43 cases. In only 18 of these did the patient complain of any associated pain.

Treatment varied over the years to such an extent that no valid statistical conclusion can be drawn as to the effectiveness of any one form of therapy.

Metastases were present in 36.7 per cent of the patients on admission and developed in 22.4 per cent later. Thirty-nine cases had no known metastases at any time.

The location of the lesion was 58 per cent lateral border, 21 per cent base, 4 per cent mid-dorsum, and 15 per cent anterior third of the tongue.

Radionecrosis and hemorrhage were the most frequent complications, occurring in 11 and 10 cases, respectively. Other complications were oral fistulas and ankylosis of the temporomandibular joint.

The most important factor in the prognosis was the presence or absence of metastasis. The survival rate among those patients entering with metastases was 5.5 per cent, in those in whom nodes developed later it was 22.7 per cent, and in those with no known nodes at any time, 36 per cent. The presence of syphilis dropped the survival rate to 8 per cent. Age and location seemed to be of minor importance. The survival rate calculated on the Memorial Hospital method was 25.0 per cent. The absolute survival rate was 24.5 per cent.

Nine tables.

A. J. NICHOLAS, M.D.
Charity Hospital, Shreveport, La.

Statistical Results in 313 Cases of Cancer of the Larynx Treated by Roentgen Therapy from 1928 to 1946 at the National Cancer Institute of Milan. Pierluigi Covo and Bruno Antoniazzi. Radiol. clin. **21**: 268–284, July 1952. (In French)

The authors present the results of radiotherapy either alone or combined with surgery in 313 cases of cancer of the larynx treated at the Cancer Institute in Milan between 1928 and 1946. The results are given according to the location of the tumor in the larynx. The chief conclusion from this study is that those cases which ran a relatively favorable course had relatively short treatment; in this group relatively favorable results and recurrences prevailed. In the cases with protracted and fractional treatment good results were almost nil and, since there were no cures, no recurrences are tabulated.

Twenty illustrations.

CHARLES M. NICE, M.D.
University of Minnesota

Roentgen Therapy in Cancer of the Extrathoracic Portion of the Oesophagus. Bertel Jørgsholm. Acta radiol. **38**: 61–78, July 1952.

During the period 1931–44, inclusive, a total of 452 patients with esophageal carcinoma were referred to the Radium Centre in Copenhagen. In 109 cases the growth affected the extrathoracic portion of the esophagus, *i.e.*, the part from the pharyngeal opening down to the level of the jugular notch. No patient was refused treatment. In 52 of the cases the tumor was situated at or in the vicinity of the pharyngeal opening. Sixty-

three per cent occurred in women at the typical post-cricoid site; 75 per cent of the growths in males were on a level with the jugular notch. Metastases were present at the first examination in 44 cases (40 per cent), mainly in the form of palpable cervical and supraclavicular lymph nodes.

Therapy was individualized, and its basic principle was that of fractionation. Twenty-five of the 67 patients receiving a "complete fractionated roentgen treatment" had metastatic disease. The tumor dose ranged from 3,200–10,200 r in the course of twenty-one to ninety-eight days, with 0.5 mm. Cu or a Thoraeus filter, 165–180 kv., focal-skin distance 50–70 cm., 2 to 7 fields (6 × 8 cm. to 10 × 15 cm.). The daily dose was 100 to 200 r in one or two daily sessions. Eight of the patients received rotational therapy.

The time at which treatment was terminated was determined by clinical observation, roentgenologic evidence of reaction of the tumor, and the patient's general condition. Eight of the 109 patients with extrathoracic esophageal cancer (7.3 per cent) were alive and well for five years. In the 67 patients who received complete treatment the relative survival rate was increased to 11.9 per cent.

The author concludes that a certain small percentage of these growths appears to be radiocurable, even though they receive only a moderate tumor dose within a certain range. An increase in the tumor dose or the period of treatment beyond the limits of this range does not increase the curability of cancer of the extrathoracic esophagus.

Five roentgenograms; 2 drawings; 3 graphs; 2 tables. I. R. BERGER, M.D.
VA Hospital, Atlanta, Ga.

Technic of and Indications for Mediastinal Roentgen Therapy in Treatment of Adenopathic Complications of Primary Tuberculosis in the Infant. Cl. Béraud. J. de radiol. et d'électrol. **33**: 370–376, 1952. (In French)

Roentgen therapy of tracheobronchial adenopathies was tried from 1920 to 1928 and abandoned. Since, however, it has been found of value in peripheral tuberculous adenopathy, the author decided to utilize irradiation in 25 cases of resistant mediastinal lymphadenopathy, especially in those producing atelectasis. Small doses, similar to those used in treating inflammations, were administered, starting with doses as low as 25–30 r. It was noted that atelectasis cleared, and that the evolution of nodal disease was accelerated. It is hoped that this treatment will prevent bronchiectasis which may result from long-standing atelectasis in patients with mediastinal lymphadenopathy.

Eight roentgenograms. CHARLES M. NICE, M.D.
University of Minnesota

Features of Electron Treatment of Cancer of the Cervix and Its Results on the Basis of 616 Cases. E. Vogt. Strahlentherapie **89**: 79–89, 1952. (In German)

During the years 1930–42, 616 patients suffering from carcinoma of the uterine cervix were treated at the Gynecological Clinic of the Heinrich-Braun Hospital of Zwickau. Of these, 509 received combined treatment with radium and roentgen rays; 107 patients underwent a radical abdominal vaginal operation, frequently in association with preoperative and postoperative irradiation. The author reports his own results and supplements v. Mikulicz-Radecki statistics on the so-called "elective therapy" of the carcinoma of the cervix. This plan of operating upon a selected group of patients and irradiating all others has been practiced for twenty to thirty years in many leading European clinics.

The overall five-year cure rate for elective therapy (4,254 cases) is 29.4 ± 0.7 per cent, and for radiation therapy only (5,669 cases) 25.7 per cent ± 0.6 per cent. The author does not discuss whether the two groups are comparable. ULRICH K. HENSCHKE, M.D.
Ohio State University

Results of So-called "Operation after Preliminary Irradiation" in Cases of Carcinoma of the Cervix. Hans Reichenmiller. Strahlentherapie **89**: 4–25, 1952. (In German)

This article is written in honor of the seventy-fifth birthday of August Mayer, the former director of the Gynecologic Clinic of the Tübingen University and one of the pioneers in radiotherapy of carcinoma of the cervix. Reichenmiller discusses the treatment policy of Mayer, who after 1919 operated upon suitable cases of carcinoma of the uterine cervix after preoperative x-ray and radium therapy. The waiting period between irradiation and surgery was at least six weeks and in more than half of the patients three months or more. Hyperemia was not observed at operation; however, dissection was more difficult. Reichenmiller concludes that operation after a full course of irradiation is a valuable procedure if the tumor has not completely regressed or if a recurrence occurs.

Eleven tables. ULRICH K. HENSCHKE, M.D.
Ohio State University

Intracavitary Radium Technique in the Treatment of Cancer of the Cervix Uteri. James A. Corscaden and Robert A. Butz. Am. J. Roentgenol. **68**: 47–57, July 1952.

The Fifth Annual Report on Results of Radiotherapy in Cancer of the Uterine Cervix (League of Nations) reveals for the years 1936–44, in 1,267 cases of Stage I an average five-year cure rate of 62.5 per cent (maximum 88.2 per cent, minimum 44.8 per cent), and in all cases (7,673 patients) an average five-year cure rate of 37.8 per cent (maximum 53.3 per cent, minimum 26.3 per cent). The authors note that the difference of 100 per cent in the cure rates can be explained in part by the technic employed. To improve results the following points are emphasized:

1. A plan of distribution of radium sources which spreads the radium widely in the pelvis should be employed.
2. The axis of the uterus is at an angle of about 90 degrees with the axis of the vagina. Plugs, in order to fit snugly into the lateral fornix, should lie in the axis of the vagina. Plugs will be displaced from this position by any applicator which has a handle which holds the plug in a position at right angles to the handle and by the slipping of the plugs during vaginal packing.
3. The position of the radium should be determined in each case by roentgenography and the gamma roentgen dose calculated for certain points in the pelvis including the mucosa of the bladder and rectum.

4. A small amount of radium applied over a long period of time gives better clinical results and causes less injury than a large amount of radium for a short time.

A device is presented which holds the radium sources in the vaginal axis, perpendicular to that of the uterus. It consists of a raflex tube to hold two or three 10 mg. tubes of radium; a plaque to hold two 5 mg. tubes of radium 1 cm. apart and 0.5 cm. from the surface of the cervix; plugs to lie in each lateral fornix on the ends; and flat springs bent so as to exert a lateral pressure of one pound when fastened together with a sleeve. The widest unit (the plaque) is only 2 cm. wide and can be inserted into almost any vagina no matter how distorted.

Eleven illustrations, including 3 roentgenograms; 5 tables.

WINSTON C. HOLMAN, M.D.
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The Role of Interstitial Radium Therapy in the Treatment of Cancer of the Cervix Uteri. George W. Waterman and Sumner I. Raphael. Am. J. Roentgenol. **68**: 58–62, July 1952.

The authors discuss the "how and why" of their treatment of cancer of the cervix with interstitial radium. Needles of the Belgium or French type are used; they carry 2–3 mg. element and are filtered by 0.5 mm. platinum, thus excluding all but the ultrapenetrating gamma rays. They can be left in the tissues for a protracted single treatment up to seven days. Regaud recommends a protracted treatment of seven days in order that cancer cells not in active mitosis during the early phase of the treatment may be acted upon in the succeeding days. A wide and fairly uniform distribution of the needles, about and in the tumor, is possible as well as individualization of treatment.

The dangers in the use of radium needles are those having to do with infection arising from the need of thrusting the needles through infected vaginal tumor tissue, with resulting parametritis and vaginitis. Such complications have occurred relatively few times in the authors' series and therefore have not lessened the enthusiasm created by the excellent primary and long-term results in the majority of cases.

Under general anesthesia the patient is examined to determine the extent and direction of the lesion. The needles are inserted at about 1.5 cm. intervals in the tumor tissue, as near the advancing outer zone as possible, as determined by palpation. Three mg. needles are used in the parametria, two, three, or four needles on each side depending on tumor size. Shorter 2 mg. needles are used anteriorly and posteriorly, the posterior needles being directed by the rectal finger. A 20 mg. capsule is placed in the cervical canal and its outer end sutured to the cervix. A fairly firm pack of iodoform gauze is placed in the vagina distending it slightly. A silk suture approximating the labia prevents the pack from slipping. The idea is to treat the tumor with interstitial radium and the lateral parametria and lymph node area with external deep roentgen therapy. Roentgen therapy is given before radium only in the advanced or badly infected case. Five or six weeks is allowed to pass before the radium is inserted.

An empirical dosage plan is being used until radiation physicists work out a simplified method of gamma roentgen determination in the actual tumor mass and in the remaining pelvic tissues.

In 321 consecutive primary cases of cancer of the cervix treated by the authors between 1936–44, there were 146 five-year relative survivals, or 45.5 per cent.

WINSTON C. HOLMAN, M.D.
Charity Hospital, Shreveport, La.

The Role of Roentgen Therapy in the Treatment of Cancer of the Cervix Uteri. J. A. del Regato. Am. J. Roentgenol. **68**: 63–65, July 1952.

The usefulness of curietherapy combined with external pelvic roentgen irradiation in cancer of the cervix has long been accepted, but the actual value of adjunctive roentgen therapy has been variously understood and utilized. The author states that our greatest possibility for improving results, particularly in the treatment of advanced cancer, lies in the understanding of the role and in the adequate utilization of external pelvic irradiation. An association of external roentgen therapy and internal curietherapy offers numerous difficulties and limitations. A well calculated joint plan is necessary for each case. The usefulness of this associated therapy is limited or nullified when both treatments are carried out independently and when amateurs permit themselves to juggle inexpertly with the serious facts involved. Often the failures of radiotherapy of carcinoma of the cervix are blamed on the so-called radioresistance of many of these tumors. Actually, this widely misused word becomes a shield for inadequate irradiation and an excuse to use new, perhaps less successful, forms of treatment.

Failures of radiotherapy are more often due to recurrence of the tumor at a point where the dose administered was insufficient, while elsewhere the dose received may have been unnecessarily high.

The advent of supervoltage therapy has made one fact evident: its use has not resulted in the betterment of the results obtained by the unskilled, while it permits an easier handling of the problems faced, and about the same results with lesser risks.

Any effort to express internal dosage (administered in a few days) in gamma roentgens and to compound it with the dosage administered from outside (in a period of several weeks) fails to acknowledge the importance of the time factor in radiobiology. Moreover, we have no knowledge of the dose which within given circumstances of accrual, protraction, etc., will with certainty result in sterilization of the tumor.

Homogeneity of irradiation is not possible but is best approached when radiotherapy of carcinoma of the cervix is considered primarily from the point of view of external roentgen irradiation and when one thinks of internal radium treatment merely as an adjunct intended to compensate for the inherent deficiencies of the external irradiation. External irradiation should be undertaken first and adapted to the circumstances of the case. The size of the fields and the reaction of the roentgen-ray beams should correspond to the symmetric or asymmetric spread of the tumor, and the area of maximum dosage concentration not necessarily medial but sometimes eccentric. Irradiation of all parts of the tumor as frequently and as evenly as possible should be the guiding principle. A protracted treatment, preferably over at least eight weeks, should be contemplated in order to eliminate the complication of irradiation sickness and to exploit to a maximum the differential effect upon the tumor and the normal structures which is enhanced by protraction. Transvaginal roentgen therapy instead of radium has as its main ad-

vantage the possibility of more extensive utilization of external roentgen irradiation which in the final analysis is responsible for the control of a greater number of cases. Since the intensity of the irradiation at the midline can be greatly reduced, a smaller proportion of radionecrotic fistulas results from this association.

Whether you see radium or transvaginal roentgen therapy, whether you use supervoltage or ordinary roentgen-ray equipment, your results in the treatment of carcinoma of the cervix can only be improved by your intelligent exploitation of external pelvic roentgen irradiation.

A. J. NICHOLAS, M.D.
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Treatment of Carcinoma of the Cervix Uteri. Isodose Surfaces in Cases Treated with Parametrial Needles and Intracervical Tandem. Russell L. Nichols and James W. J. Carpender. Am. J. Roentgenol. **68**: 72–78, July 1952.

A study of the use of low intensity interstitial radium needles and intracervical tandem for the treatment of carcinoma of the cervix, based on the work of Pitts and Waterman, and Waterman and Di Leone is presented. Unselected cases treated for carcinoma of the cervix by the staff of the University of Chicago Lying-in Hospital were studied. The application of radium, surgery, and subsequent care were directed and carried out by the gynecology staff. On the basis of studies carried out for pelvimetry, the authors believe that the position of the radium needles at the time of filming can be reproduced to within 2 mm. The movement of the radium needles within the pelvis was slight. A dose calculator was constructed with seven separate elements, each element reproducing the position within the pelvis of a single radium source. Isodose curves for the single linear sources were derived from the tables and monograms of Wolf and from the tables by Quimby. Systematic determinations were carried out at planes separated by 1 cm.

Seven cases were worked up in detail, 4 of which are presented with the following conclusions:

1. Deficiencies in the dose distribution of these cases were:
   a. The area of highest dosage lies well above the cervix, probably near the center of the uterine body.
   b. The zone of carcinocidal effect is frequently misplaced lateralward or posteriorly.
   c. Rectosigmoid, cecum or loops of small intestine may be found in the high dose zones.
   d. The vaginal wall is consistently in a zone of low dosage.
   e. The region of the "principal" lymph node does not receive a carcinocidal dose from radium application alone.
   f. Combined radium application and external irradiation does not bilaterally raise the region of the "principal" lymph node to a carcinocidal dose. When a carcinocidal dose is obtained at one pelvic wall, it is at the expense of a gross underdosage on the opposite wall.
   g. The lymph nodes of the obturator foramen are in a zone of very low dosage.
2. Despite theoretical predictions of improved parametrial dose by interstitial needles, these cases fail to show such improvement.
3. While it is true that improvements in dose to the pelvic wall can be accomplished by various arrangements of interstitial needles, the improvement is attended by great complexity with its consequent inconsistencies.

Isodose curve on 4 cases, an isodose curve and radioautograph of a radium tube, and a photograph of the radium dose calculator are presented.

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The Cytological Approach to Uterine Carcinoma: Detection, Diagnosis, and Therapy. E. L. Hecht. Am. J. Obst. & Gynec. **64**: 81–90, July 1952.

The cytologic method represents a threefold approach to the problem of uterine cancer: early detection of malignancy, differential diagnosis, guidance and control of therapeutic procedures. At the Post-Graduate Hospital, from which this report comes, vaginal, cervical, and endometrial smears are a part of all routine gynecological examinations.

Squamous-cell carcinoma of the cervix is classified on the basis of the cell picture as undifferentiated and differentiated. In undifferentiated cells the cytoplasm is an indistinct background with absence of cell borders, while differentiated cells have well defined cytoplasm and fairly definite borders. The criteria for a diagnosis of malignant growth are nuclear, including an irregular chromatin network, increased chromatin content, and variation in nuclear size and shape. There are three main types of differentiated malignant cells: the elongated fiber cell with a long hyperchromatic nucleus; the "tadpole" cell with a deep-straining nucleus in the "head" and a "tail" of cytoplasm; and the most differentiated cell resembling an inner basal-layer cell but with a hyperchromatic nucleus and an abnormal cytoplasmic-nuclear ratio. Undifferentiated cells are the most common type seen in vaginal smears. Positive diagnosis is easier when groups of cells make possible comparison of size and shape.

Histiocytes, endometrial, and endocervical cells may be confused with undifferentiated malignant cells. Degenerate endometrial cells may be especially confusing, and endometrial aspiration may be helpful in eliminating these. False negatives may result when tumor cells are not shed, in the presence of severe secondary infection, and from misinterpretation of suspicious looking cells.

Biopsy should be done to corroborate a positive diagnosis, although early cervical cancer may sometimes be detected by smear when biopsy is negative.

Cells from endometrial adenocarcinoma show the same characteristics as those of endocervical adenocarcinoma. Differentiated cells have distinct borders, frequently a vacuolated cytoplasm with a large eccentric nucleus causing a "signet ring" appearance, and typically malignant nucleochromatin. Undifferentiated cells have a tendency to occur in tight groups. Cell borders are indistinct, and vacuolization of cytoplasm is less marked. The nuclei are typically malignant. Endometrial aspiration distinguishes the endometrial from the cervical cells and eliminates degenerated endometrial cells.

The vaginal smear is an accurate indicator of tumor radiosensitivity and a means of detecting malignant recurrence after surgical or radiation therapy. Radiation changes in normal cells are increase in size of the

nucleus and cytoplasm with no disturbance of the nucleocytoplasmic ratio; marked cytoplasmic and frequently nuclear vacuolization; and presence of bizarre forms. Basal cells are the first normal cells to show post-irradiation change, but these are seen only if the smear contained basal cells before irradiation. Few basal cells are seen in premenopausal patients, and the first changes are then observed in the precornified cells. Basal cells begin to show radiation effect at about one week, and precornified cells at about the fifteenth day.

Malignant cells show radiation effects in about twenty-four hours after the onset of treatment. The changes are similar to those in normal cells except that the nuclear size increases tremendously and the malignant nuclear characteristics are accentuated. Malignant cells usually disappear in eight to ten days, but may persist six weeks or more. At three months most radiation changes in normal cells disappear, and no malignant cells should be found.

Vaginal smear is useful in detecting post-irradiation recurrence when scarring may prevent direct visualization or biopsy of the cervix.

Endometrial smears have given evidence of such nonmalignant conditions as polyps, fibroids, endometrial hyperplasia, and luteal phases of the endometrium.

Eleven photomicrographs.

MASON WHITMORE, M.D.
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A Study of the Complications Resulting from Treatment of Cancer of the Cervix. Norman A. McCormick. Canad. M. A. J. **67**: 25–28, July 1952.

The author analyzed the histories of all patients treated for cancer of the cervix on the Neoplastic Service of the Metropolitan General Hospital, Windsor, Ontario.

Patients with cancer of the cervix at this hospital receive 200 r, as measured in air, of heavily filtered 200 kv. roentgen therapy, administered at 80 cm. skin-target distance, on two areas daily for a total of 2,000 r to each of six external pelvic portals; four 25 mg. intra-uterine radium capsules are inserted immediately, in tandem, to deliver 3,000 mg. hr. Three days later five 10 mg. needles uniformly spaced 1 cm. from the surface of a sponge rubber applicator are placed in the vaginal vault for 2,500 mg. hr. Until 1939, an additional 500 mg. hr. were given intravaginally.

Prior to Dec. 1, 1948, 288 patients were treated for primary or recurrent carcinoma. Radiologic complications developed in 31. Thirteen of 19 patients with proctitis had only transitory reddening of a small area of rectal mucosa with slight bleeding for a short time. One has periodic diarrhea. Mucosal ulcers appeared in the rectal wall adjacent to the cervix in 5 patients. Two of these healed spontaneously, and the patients have remained well. One patient had a colostomy and subsequently died of uncontrollable cancer. Rectal ulcers developed in 2 patients after retreatment with radium for residual disease. One died of uncontrollable cancer. In another rectovaginal and vesicovaginal fistulas developed. The rectal fistula was repaired and bilateral loin ureterostomy was done for extensive bladder damage. In 2 patients a vesicovaginal fistula developed; one patient died in the sixth year of pyelonephritis with no residual cancer and the other died of pyelonephritis after thirteen years with no residual disease. Five women had mild but permanent bladder fibrosis; one died of cancer, the others have occasional frequency.

Prior to reduction of the radium dose from 6,000 to 5,500 mg. hr., the incidence of complications was 23.6 per cent. Since 1939, it has been 6.5 per cent. The absolute five-year survivals for the two periods was 33 and 49 per cent, respectively. Fifteen per cent of the patients requiring retreatment suffered complications, but a 10 per cent five-year salvage rate has been obtained in this group.

Two graphs; 4 tables.

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Roentgen Therapy for Ovarian Dysfunction. Eugene T. Leddy. S. Clin. North America **32**: 1101–1104, August 1952.

Those who are interested in the development of roentgen therapy for ovarian dysfunction are referred by the author to the earlier work of Drips (Am. J. Obst. & Gynec. **55**: 789, 1948. Abst. in Radiology **52**: 616, 1949) and others. At the Mayo Clinic, from which the present report comes, irradiation is given to the pituitary, the ovaries, or both, as examination of the patient and clinical experience indicate. The pituitary is irradiated through two bitemporal fields (7 × 7 cm.) with the beam of rays focused on the center of the gland. As a rule, for a total dose of 150 r (in air) to the two fields, the factors are 200 kv., 0.5 mm. Cu filter, 50 cm. target-skin distance. In this manner, a dose of about 100 r is given to the pituitary body through the two fields. Each ovary is irradiated through a large (10 × 15 cm.) field centered over it. The time of irradiation is five minutes, and the other factors as given above. With this method, it is estimated that the ovary receives a dose of 50 r. Usually, both ovaries are treated in one session. When clinical indications call for irradiation of both the pituitary body and the ovaries, the four fields are usually irradiated one after the other.

X-Ray Therapy in the Management of Chronic Pelvic Inflammation. George A. Williams and Abraham S. Velkoff. South M. J. **45**: 660–662, July 1952.

At Grady Hospital (Atlanta, Ga.), it was noticed over a period of many years that none of the patients with exacerbations of pelvic inflammation was postmenopausal. Those who had frequent recurrent bouts of pelvic inflammation ceased to come to the clinic after the menopause was established. It was decided to give patients too ill for operation a "castrating" dose of x-rays (1,800 r). It is not specified as to whether this dose is measured in air, on the skin, or at the mid-line tissue level. Field size, position, and duration of therapy are also not mentioned.

Thirty-two patients were treated, varying in age from twenty-three to forty-nine years. All had serious chronic pelvic inflammation of more or less lengthy duration with frequent disabling exacerbations. The results have been gratifying. All draining sinuses promptly healed. Inflammatory masses gradually became less painful and sensitive, and a gradual improvement of the blood picture occurred. Only 2 cases must be classed as complete failures.

The authors conclude that the beneficial results are due to the castration of the patient. However, since inflammatory conditions *per se* respond favorably to irradiation, one wonders if this action on the disease itself is not also quite important.

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RADIOISOTOPES

Clinical Uses of Radioactive Isotopes. J. R. Maxfield, Jr., and Jack G. S. Maxfield. Texas State J. Med. **48**: 449–453, July 1952.

A brief résumé of most of the important uses of radioactive isotopes is presented. In diagnosis the most spectacular work with isotopes has been in the use of diiodofluorescein for the detection of brain tumors. One of the most valuable procedures has been found to be the administration of radioactive iodine to determine the state of thyroid function and in thyroid cancer and/or metastases.

In the therapeutic field, radioactive iodine deserves first consideration in the treatment of hyperthyroidism and certain carcinomas. Radioactive phosphorus is the treatment of choice in patients with polycythemia vera. It is useful also in leukemia (chronic) and in some cases of multiple myeloma, lymphoblastoma, and bone metastases from breast cancer. There has been increasing use of radioactive colloidal gold in recent months. It is advantageous in treatment of inoperable carcinoma of the prostate and in certain inoperable tumors in which interstitial injection can be carried out. Abdominal and pleural injection will control metastatic implants and reduce or stop production of ascitic fluid. Radioactive cobalt offers a new weapon in the armamentarium for the treatment of malignant disease by the use of the flexible nylon applicators, sheath needles, and high intensity sources and as telecobalt units. Its greatest drawback is its short half-life. Radioactive strontium is a beta emitter of considerable value in treating lesions of the eye.

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Lingual Thyroid: With Report of a Case. Herbert J. Dietrich and LeRoy A. Schall. Ann. Otol. Rhin. & Laryng. **61**: 395–399, June 1952.

The incidence of lingual thyroid is reported to be about one in 2,500 to 4,000 cases of all types of thyroid disease. It is said to be more common in the female.

When thyroid tissue resides at the base of the tongue, it is as a rule all, or nearly all, of the thyroid tissue possessed by the patient. It may be normally functioning thyroid, or it may be a gland, the seat of any of the diseased states which may affect the gland in its usual position. This includes tumors, adenoma, and carcinoma.

The condition is usually discovered unexpectedly during the examination of the patient who presents himself for treatment of mild sore throat or spasmodic coughing attacks if the lesion is small. Occasionally the lesion may have attained sufficient size to produce dysphagia or dyspnea and associated signs of respiratory distress. In some cases, sudden and rather profuse bleeding from the vessels coursing over the surface of the tumor may be the first symptom.

The appearance of the lesion, best seen when the tongue is drawn forward, is that of a smooth, circumscribed swelling, bluish-red in color and confined to the area at the base of the tongue. Its consistency is soft, giving the impression of an encapsulated tumor. The conditions requiring differentiation are: (1) simple cysts of the lingual tonsil, (2) mixed tumor of the base of the tongue, and (3) some types of angiomata.

The diagnosis may be suspected on clinical examination, especially if the thyroid gland in the normal position cannot be palpated. Biopsy of the lesion would help to settle the diagnosis if other methods are not available. By means of radioactive iodine (I^{131}) the diagnosis is rendered fairly certain without first recourse to biopsy or excision of the mass.

A tracer dose of I^{131} is administered in a dosage of 20 microcuries in 250 c.c. of water in the form of "cocktail" which the patient drinks. Forty-eight hours later a Geiger counter is pointed toward the various regions under consideration. The counts obtained over each site are tabulated and the total uptake of radioactive iodine estimated. The preponderance of thyroid tissue will reside in those regions showing the higher counts.

A case of lingual thyroid, in a 30-year-old white male, is presented together with the results of a therapeutic test of radioactive iodine.

The authors recommend leaving a normal lingual thyroid *in situ* if it isn't causing the patient more than occasional discomfort. If the tumor enlarges, causing dysphagia, respiratory distress or bleeding, surgery should be employed.

Once surgery has been decided upon, complete removal of the tumor is advocated and not partial excision undertaken with an idea of preserving some functional thyroid tissue. The reason for complete removal is that regeneration and reappearance of the mass is entirely possible otherwise. The probabilities would be in favor of having to employ replacement therapy should myxedema develop.

The importance of complete histological studies of specimens of thyroid removed is stressed, including radioautographs, if a therapeutic dose of radioactive iodine precedes the surgery.

One photograph; 1 diagram.

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Indications and Contraindications for Treatment of Thyroid Cancer with Radioactive Iodine. William H. Beierwaltes. Ann. Int. Med. **37**: 23–30, July 1952.

After ten years of experience with radioactive iodine, the author still considers total thyroidectomy the most effective method of treating thyroid cancer. Surgical removal of the neoplastic thyroid gland usually prevents death from compression or invasion of the trachea, the esophagus or the superior vena cava. Total thyroidectomy in such cases also removes normal thyroid tissue. If functioning thyroid is not removed, its hormone continues to check the pituitary's production of thyroid stimulating hormone (TSH). When this source of thyroid hormone is removed, the pituitary's increased secretion of TSH tends to increase the capacity of metastatic thyroid cancer to pick up radioactive iodine. Radioactive iodine is therefore not indicated unless a patient has first had a total surgical thyroidectomy.

The author does not believe that radioactive iodine is any substitute for x-ray therapy but rather is indicated when metastases are disseminated or because previous roentgen therapy has been ineffective.

The histology of the tumor is important since the best response to radioactive iodine is obtained in follicular and alveolar carcinomas. Papillary carcinomas

show less response and undifferentiated carcinomas show no response. When possible, one or more of the metastases should be examined, since some cases showing favorable histology in the primary tumor will have very anaplastic metastases with no ability to concentrate the iodine.

The next step in a favorable case is to demonstrate and measure the ability to concentrate the I^{131}. Four methods commonly used to test the ability of the cancer to concentrate iodine are autoradiography, external gamma counting, urinary excretion of I^{131}, and I^{131} level in the circulating blood.

Thiouracil and its derivatives produce the same response as surgical thyroidectomy, but are more effective after total surgical thyroidectomy if given for two months or longer and then stopped for two days before I^{131} is administered. No thyroid-stimulating hormone is commercially available at present.

Three temporary contraindications to I^{131} therapy are myxedema, desiccated thyroid or iodide administration, and hypoplastic marrow. Patients with hypoplastic anemia or marrow made hypoplastic by irradiation should have no further I^{131} treatment until clinical evidence of adequate cellular regeneration is present.

Three photomicrographs; 1 autoradiograph; 2 drawings.

ZAC F. ENDRESS, M.D.
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Simple Routine Methods for the Determination of the Function of the Thyroid Gland Following the Oral Administration of a Harmless Tracer Dosage of Radioactive Iodine (I^{131}). Heinrich Fassbender and Carlos Werner Fassbender. Fortschr. a. d. Geb. d. Röntgenstrahlen **77:** 103–107, July 1952. (In German)

The determination of the function of the thyroid by means of radioactive iodine (I^{131}) is the only objective test of thryoid function and is probably destined to gradually replace all heretofore used indirect methods. A normal thyroid gland will retain between 15 and 35 per cent of an orally administered dose of I^{131}. In hyperthyroidism up to 80 per cent is retained, while in hypothyroidism the uptake is less than 15 per cent. The excretion of the iodine in the urine is complimentary to the storage within the thyroid. If less than 65 per cent is excreted hyperthyroidism may be assumed and if more than 85 per cent is excreted hypothyroidism is probably present.

The indirect calorimetric methods of determining the basal metabolic rate are inaccurate because they are dependent upon the emotion of the patient. Furthermore, hypertension, leukemia, tumors, psychoneuroses, etc., may markedly influence the test.

If I^{131} is given orally, the amount of iodine retained within the thyroid gland may be measured directly with a counting device. Because of variations in the form and size of the thyroid, however, these direct measurements are inaccurate. Much more accurate is the determination of the excretion of the iodine in the urine within the twenty-four-hour period following administration of the I^{131}. The only condition which might impair the accuracy of this test is an inhibition of the urinary output of the patient, as in circulatory decompensation or decompensation of the kidneys. The irradiation of the I^{131} consists of beta rays with a maximal energy of 0.6 mev and of gamma rays of 0.65, 0.37, and 0.08 mev. For measuring iodine excreted in the urine, the beta rays or the gamma rays may be used.

The authors prefer to measure the beta rays because of the simplicity of the procedure. Twenty microcurie of I^{131} are diluted in 100 c.c. of water. The patient drinks one-half of this amount in a glass of lemonade. The other half is used later as a standard for measuring. The urine is collected for the first twenty-four hours after the administration of the iodine. The volume and the specific gravity are measured. Supposing the volume amounts to n c.c. and the specific gravity is s; enough salt is added to the standard fluid so that, when it is later diluted to the volume n, it will have exactly the same specific gravity as the urine. This is easily done according to the formula of Lenard. According to this formula, it is necessary to add to the standard fluid $n \times (s - 1)$ grams of salt. Then, enough water is added to the standard solution to make n c.c. of fluid to make the volume of the standard solution and of the urine equal. It may be advisable to add to the urine, as well as to the standard fluid, 0.5 grams of inactive sodium iodide to make the wall absorption of I^{131} as small as possible. The same type of glass vessel is used for both fluids. The impulse frequencies of the urine and of the standard fluid are then measured. They are proportional to the radioactivity. Therefore, the percentage of the excreted I^{131} is $P = 100 \times f_1/f_2$, where f_1 shall be the impulse frequency of the urine and f_2 the impulse frequency of the standard fluid. The wall of the counting tube must be very thin to allow a high percentage of the beta rays to enter the counting tube.

If the gamma activity is to be measured, one proceeds in the following manner: The urine and the standard fluid, the latter being brought up to the same volume, are placed in identical glass vessels. One of the vessels is placed in the middle of a circle, along the periphery of which are several gamma counting devices connected in parallel. The activity is measured first in one and then the other. The distance between the vessel wall and the circle of the counting tubes should be a few centimeters. It is advisable to bring the urine and the standard fluid up to the same volume, for instance 1,500 c.c., in order to have the same geometrical conditions between the counting device and the radioactive fluid. The counting tubes should have a high degree of sensitivity; this is achieved by using a cathode of lead or gold, or rather a copper cathode with a lead or gold surface, which increases the sensitivity four or five times.

Both methods give good results. The measuring of the gamma activity is, perhaps, the more sensitive.

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The Nature of the Serum Iodine after Large Doses of I^{131}. Jacob Robbins, J. E. Rall, David V. Becker, and Rulon W. Rawson. J. Clin. Endocrinol. & Metab. **12:** 856–874, July 1952.

The administration of a large dose of radioiodine to man and to the rat is sometimes followed by a temporary rise in the level of serum protein-bound iodine. The blood iodine normally present in man and in the rat is almost entirely thyroxine, loosely attached to the serum proteins. Twenty patients were studied (5 cases of Graves' disease, 3 cases without thyroid

disease, 1 case non-toxic nodular goiter, and 11 cases of carcinoma of the thyroid with follicular components in the carcinoma). Eleven patients received tracer doses of I^{131} in the amount of 2.0 millicuries or less, and 16 patients received therapeutic doses of radioiodine in amounts ranging from 8.9 to 254 millicuries. Radioiodine was administered orally in the form of iodide containing 10 micrograms or less of carrier iodide. The serum radioiodine in the patients who received tracer doses of I^{131} was indistinguishable from thyroxine. In 10 of the 16 patients who received therapeutic doses of I^{131} it was found that, although the serum iodine was largely precipitable, only 12 to 66 per cent was butanol soluble, *i.e.*, indistinguishable from thyroxine. After alkaline hydrolysis, the butanol-insoluble radioiodine fraction was shown to release thyroxine, diiodotyrosine, and iodide in proportions comparable to those found in thyroglobulin. The occurrence of this abnormal material in the blood appeared to be related to the amount of radiation delivered to the thyroid tissue. Clinical observation of the patients revealed a correlation between the abnormal serum fraction and the degree of thyroid tissue destruction in that it was most pronounced in those patients who had the most severe radiation damage.

The study also demonstrates that the serum radioiodine elaborated by functioning carcinoma of the thyroid appears to be identical with thyroxine.

Four figures; 2 tables.

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Calculations for Distributed Sources of Beta Radiation. H. H. Rossi and R. H. Ellis, Jr. Am. J. Roentgenol. **67:** 980–988, June 1952.

The problem of beta-ray dosimetry is analyzed. With a uniform isotope distribution of a beta emitter within a large mass of homogenous tissue the energy emitted is the energy absorbed. If the volume containing the beta-ray emitter has dimensions comparable with the beta range, then dosimetry becomes more complex. This is of paramount importance as with thyroid metastases of about 1 mm. size or less the maximum beta effect from I^{131} will be outside the neoplastic volume. Knowledge of the maximum beta energy, which controls beta absorption in tissue, is necessary, particularly when dealing with scattered sources.

Experimental points of the average absorption coefficient (in tissue equivalent material) for three different isotopes with different E_{max} emission were plotted. From this the average absorption coefficient of any beta emitter falling between the soft radiation of S^{35} and the energetic one of P^{32} can be obtained. Using the approximation that beta radiation is absorbed exponentially the authors analyze dosage distribution in two classes of geometrical shapes, *i.e.*, slabs and spheres. It is felt that for practical working purposes such an assumption is valid for a biological system. Knowing thickness of the emitter, distance of source from surface, average absorption coefficient and the activity in millicuries per area (thin slabs) or volume (thick slabs or spheres), the dose in equivalent roentgens can be determined by the formulae developed by the authors. A practical problem for each of the above geometrical shapes is analyzed.

Nine figures.

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Radioactive Cobalt as a Radium Substitute and as a Gamma Source for Interstitial, Intracavitary, and Plaque Applications. A Review. Isadore Meschan. Texas State J. Med. **48:** 453–459, July 1952.

Before discussing cobalt, the author reviews the advantages and disadvantages of radium as a gamma-ray source. Advantages are listed as long half-life, the many data accumulated in the past fifty-five years relating to the use of radium and radon, and the fact that it can be used either as a removable source or in the form of permanent seed implants.

Disadvantages are the cost, possible lack of homogeneity of distribution inside the needles, emission of gas, the many different energies of the gamma rays (at least 12), the 30-day delay for new sources to reach equilibrium before calibration, high-energy beta emission requiring costly sheathing, and finally the small amounts available.

$Cobalt^{60}$ is produced in the uranium piles from $cobalt^{59}$, generally in the form of wire. This is encased in a hyperchrome steel sheath to filter out the weak beta rays and to prevent oxidation and subsequent pulverization of the cobalt.

Physical calculations were made to convert the Paterson-Parker tables for use with cobalt. Biological experiments were then performed to check the results. A definite discrepancy was found, which is partially explained by differences in oblique filtration and self-absorption, but the author admits that these factors are not the entire explanation. An additional correction factor of 15 to 20 per cent is recommended in conversion from radium to Co^{60} applications.

$Cobalt^{60}$ makes easily available a great variety of needles, intracavitary applicators and even teletherapy units because of its abundance and low cost. Its half-life of 5.3 years makes necessary a correction of approximately 1 per cent for decay each month.

Two roentgenograms; 1 photograph; 2 diagrams.

ZAC F. ENDRESS, M.D.
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A Flexible Linear Gamma-Ray Source (Co^{60}) for the Treatment of Cancer of the Uterine Body. D. E. A. Jones. Acta radiol. **38:** 41–48, July 1952.

In an effort to improve the gamma-ray dosage in intracavitary uterine therapy for corpus carcinoma, the author devised a flexible linear applicator for use with $cobalt^{60}$. A length of 24 gauge stainless steel wire is wound into a close helix of the required length so that the effect of a hollow steel spring is obtained. The ends of the spring are pushed into a brass fitting and this in turn into a plug which immobilizes the spring in the fitting. The spring is then loaded with an appropriate number and arrangement of Co^{60} rods and spacers, so that the tunnel formed by the loop and the attached cylinder is completely filled up. The applicator is closed by means of the plug and secured with a silk thread passed through suitable holes drilled in cylinder and plug. The apparatus is inserted into the uterus, and the vagina is packed in the usual way.

The applicator when loaded provides a delivery of at least 6,000 r in two 22-hour periods to a closed surface at a uniform distance of 1 cm. from the piriform plane, representing a transverse section of the uterine cavity. The apparatus has been used in 5 patients with uterine cancer with satisfactory results.

Two illustrations.

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Effect of Particle Size on Blood Clearance and Tissue Distribution of Radioactive Gold Colloids. D. B. Zilversmit, George A. Boyd, and Marshall Brucer. J. Lab. & Clin. Med. **40**: 255–260, August 1952.

Preparation and Particle Size Measurement of Monodisperse Radioactive Gold Colloids. D. B. Zilversmit, George A. Boyd, and Marshall Brucer. Ibid pp. 261–266.

The authors studied the removal from the blood of dogs of radioactive gold colloids of different particle size and their distribution in various tissues. Radiogold was chosen for the investigation because of its availability, ease of measurement, and because much is known about its chemical preparation to particles of approximately known size.

One of the authors' observations would support the idea that serum protein-coated particles are handled differently than particles coated with other materials. In one dog a serum-coated gold sol was injected, followed after two hours by a gelatin-coated gold sol, which in turn was followed two hours later by an oleic acid-coated gold sol. The disappearance of the last two colloids was more rapid than the first, and in both definite "bumps" occurred in the disappearance curve twenty to fifty minutes after injection, whereas a smooth curve was obtained for the serum-coated colloid.

Relatively large colloidal gold particles were removed from the blood stream at a more rapid rate than smaller ones. The liver and spleen took up 80 to 90 per cent of the injected gold, independent of particle size within the range studied.

In the second paper a method is described with which monodisperse radioactive gold sols can be prepared and their particle size measured by means of a low-speed centrifuge. The procedure is simple enough to be used routinely in the characterization of radioactive materials before their administration to patients or animals.

Two graphs; 3 tables.

Techniques and Radiation Precautions for Intratumor Injections with Radioactive Colloidal Gold. H. Brownell Wheeler, Jack H. Rubenstein, M. Donald Coleman, and Thomas W. Botsford. Arch. Surg. **65**: 238–289, August 1952.

It is possible to localize radiation within tumors by the direct intratumoral injection of radioactive colloidal gold. The authors have employed this form of therapy on 22 occasions to treat 12 different patients. The clinical response and histological changes observed in these patients, together with a discussion of the indications, dosage levels, and the future role of such therapy, will be the subject of another paper.

Perhaps the main reason that widespread clinical use of radioactive colloidal gold has not yet been made is the technical difficulty of (1) insuring an even dispersion of the radioactive solution throughout the tumor and (2) preventing the therapist from receiving hazardous amounts of radiation when he is working with high levels of activity. These technical problems can largely be overcome by use of the special equipment and technic which are described in the paper.

Four illustrations. DANIEL WILNER, M.D.
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RADIATION EFFECTS

Radiation Injury Following an A-Bomb Explosion. Colin F. Vorder Bruegge. Ann. Int. Med. **36**: 1444–1458, June 1952.

The author places particular emphasis on the effects of a Nagasaki-type bomb detonated at an altitude of approximately 2,000 feet, which is considered to be the most effective range. Bombs of greater energy equivalents might be used, but destructive effects do not increase in proportion to the bomb size.

The casualty-producing factors of blast, thermal radiation, and ionizing irradiation from an atomic bomb are often considered individually. Studies of the victims of the Hiroshima and Nagasaki bombs, however, show it is virtually impossible to classify injuries in sharply defined groups based on the causative factor.

It has been estimated that more than half of the Japanese injured by the atomic bomb suffered burns, and that the majority of these were of the flash type due to radiant energy, as distinct from the more familiar flame burns. Thermal radiations from atomic bomb explosions include the infrared, ultraviolet, and visible light sections of the spectrum, and are transmitted in straight lines at the velocity of light. The temperature directly beneath the explosions in Japan was estimated at 3,000 to 4,000°C., but temperatures fell off rapidly with increasing distance from the explosion so that flash burns were not a problem at slightly more than two miles.

At distances of between 1,500 and 2,000 yards, the burns varied in severity from completely destructive to second degree. At about 2,000 yards the initial phase of erythema and blistering was followed in some cases by depigmentation, with little or no damage to the epithelium. Beyond 2,000 yards an intense pigmentation, reminiscent of extreme sunburn, was noted following the initial erythema.

Most of the burns became infected and extensive tissue destruction ultimately occurred, even when the initial lesion had been only a second degree burn. Infections played their most important role in persons within 1,500 yards of the blast who received a significant dose of irradiation.

Ionizing irradiation was responsible for approximately 15 per cent of the fatalities from the atom bomb burst in Japan. The most important ionizing radiations from an explosion at 2,000 feet are gamma rays, for alpha and beta particles travel only short distances through air, fission products and unexploded bomb fragments rise rapidly into the stratosphere, and neutrons have minimal effect at this range. Physicists have estimated that more than 10,000 r are delivered to the ground zero point. At a distance of two miles, the dosage is less than 1 r, and the effect is not clinically significant at slightly more than one mile. At two-thirds of a mile the dosage is from 400 to 450 r.

Observations made in Japan indicate that the lethal dose of whole-body irradiation lies in the range of 600 to 700 r. The LD 50 dose was estimated at from 400 to 450 r. Deaths from ionizing irradiation in Japan began about one week after the explosion and reached the highest level in three to four weeks. The death rate dropped to a very low level after eight weeks.

On the day of the bombing the outstanding symptoms

of the Japanese exposed to irradiation were nausea and vomiting, followed soon by fever, leukopenia, and diarrhea. Epilation, purpura, and oropharyngeal lesions appeared about two weeks after exposure. Epilation was the surest external sign of exposure to ionizing irradiation.

The lymphoid and hematopoietic tissues, skin, genital organs, and gastrointestinal tract were most severely affected by ionizing irradiation. Atrophy of lymphoid elements in lymph nodes, tonsils, spleen, and gastrointestinal tract was a prominent finding. Atrophy of the bone marrow was evident early, and in some cases it continued until death.

After treatment of the initial burns and traumatic injuries, the major therapeutic problems are hemorrhage and infection. Study of the Japanese material suggests that, if patients can be kept alive beyond six or eight weeks after exposure, regeneration of bone marrow will provide an adequate level of hematopoiesis in most cases.

Five photographs; 6 photomicrographs.

STEPHEN N. TAGER, M.D.
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Treatment of Irradiation Sickness by Means of the Oral Administration of Vitamin B_{12}. J. Dahlmann and K. Hausmann. Fortschr. a. d. Geb. d. Röntgenstrahlen **77:** 108–116, July 1952. (In German)

Renner, in 1951 (Strahlentherapie **85:** 342, 1951), reported that injections of vitamin B_{12} may markedly relieve the symptoms of irradiation sickness. The authors were anxious to determine whether the oral administration of this vitamin would accomplish similar results.

In pernicious anemia a daily injection of from 1 to 3 gamma of vitamin B_{12} will make all clinical symptoms disappear. However, orally a dosage from one hundred to one thousand times that much has to be given to produce the same results because the "intrinsic factor" (Castle ferment), which is contained in the gastric juice and which is so essential for the resorption of vitamins, is markedly diminished in pernicious anemia. If, at the same time, the gastric juice of a healthy individual is administered, then 5 gamma of vitamin B_{12} will become therapeutically effective.

The authors selected 20 patients who had to undergo prolonged x-ray therapy for cancer and who were suffering from severe symptoms of irradiation sickness. The symptoms were headache, dizziness, tired feeling, lack of appetite, nausea, vomiting, diarrhea, and acceleration of the pulse. The patients were given 30 gamma of vitamin B_{12} daily by mouth. Complete relief of all symptoms was obtained by 13 patients. In 4 patients a marked improvement was noted. Two patients responded quite well at first but a deterioration was noticed later on; in 1 patient no improvement was observed. If during the course of treatment administration of the vitamin B_{12} was stopped, the symptoms of irradiation sickness promptly returned; upon resuming the vitamin the symptoms disappeared again. A rectal administration of even double the dose of vitamin B_{12} was not effective. The daily physiological requirement of vitamin B_{12} is probably between 1 and 3 gamma; a dose of 30 gamma is therefore about ten times the normal requirement. Apparently the intrinsic factor in the stomach is not diminished by the x-ray treatments.

During the experiments the authors have made the following observations: The blood level of vitamin B_{12} is apparently only very little affected by x-ray treatments or by the oral administration of vitamin B_{12}. Oral administration is just as effective as the parenteral administration, but a higher dosage is required. The authors believe that the vitamin B_{12} works in the alleviation of the symptoms not as a vitamin but rather as a pharmaceutical agent. In the 1 case in which no benefit was derived from the vitamin, the possibility of brain metastases producing the symptoms would have to be considered. Vitamin B_{12} in *vitro* will be inactivated by x-rays. Whether such an inactivation takes place in the living organism could not be definitely established. Vitamin B_{12} plays an important role as a co-ferment in the metabolism of the nuclei of cells, particularly in the synthesis of desoxyribosenucleosides. Further, it plays an important role in the transformation of the amino acid homocystin into methionine. X-rays inhibit the fermentatively directed transformation of ribosenucleinic acid into desoxyribosenucleinic acid. The authors believe that through the action of x-rays certain histamin preparations flood the circulation and are responsible for some of the symptoms of irradiation sickness. They feel that large doses of vitamin B_{12} may prevent the disturbances in the synthesis of desoxyribosenucleinic acid.

Three charts; 1 table. WM. A. MARSHALL, M.D.
Chicago, Ill.

Radiation Hazards During Cholangiographic Examinations. Kurt Lidén and Martin Lindgren. Acta radiol. **38:** 1–7, July 1952.

The authors employed operative cholangiography on 500 occasions, entailing 2,000 exposures, in 1950. The problem of radiation protection and hazards was investigated. It was found that during cholangiography the operator's hands receive about 5 r during a single exposure, and his body a surface dose of 10–15 mr, if the exposures are made without protection during the injection of the contrast medium. (A safety dose level of 100 mr per week has been established in Sweden.) Certain protective measures have been adopted. The placing of the operator's hands in the direct beam is avoided. All operating personnel are required to stand at least 3 meters from the operating table. The radiologist makes his exposures from an adjacent room. Only the anesthetist is required to remain near the operating table. Steps to protect the anesthetist were taken when it was found that during a single procedure from 25 to 115 mr were measured on the left hand and from 20 to 80 mr on the forehead. A lead-rubber shield (lead equivalent 1.2 mm.) provided with a lead-glass window was designed, and control measurements show that it completely fulfills its purpose of absorbing the scattered radiation. The lower third of the shield is divided into three overlapping parts, and the entire shield is fixed to a mobile floor stand.

Four illustrations. I. R. BERGER, M.D.
VA Hospital, Atlanta, Ga.

Survey of X-Ray Exposures in Hospital Personnel. Egilda DeAmicis, Charles K. Spalding, and Russell F. Cowing. J.A.M.A. **149:** 924–925, July 5, 1952.

In 1949 the National Bureau of Standards recommended that the maximum total dose to which any

part of the body of a person shall be permitted to be exposed continuously or intermittently in a given time shall be 0.300 r per week. On the basis of 48 hours per week of uniform exposure, the permissible dosage rates are 6.25 mr per hour. With this permissible dosage rate as a standard, the authors established a film-monitoring program in nine general hospitals and two radiologist's offices.

Dupont dental film No. 552-2, which has been especially developed as an indicator for radiation, was selected for use in film badges. The packet consists of two films, the more sensitive having a range of 0 to 3 r and the least sensitive, a range of 0 to 20 r. Series of film packets were exposed to known amounts of x-radiation measured by means of a Victoreen 25-r condenser chamber. The films were next developed under fixed time and temperature conditions and fresh developer and hypo were used for each run. It must be noted that an increase of only a few tenths of a degree in developing temperature will cause increased photographic blackening of the film, which will result in greater density. A slight increase in developing time will also cause increased photographic blackening. Photographic graying and blackening of the films were measured on a photo cell type densitometer.

Tables are presented which show that of 1,100 film badges worn by roentgenologists over a period of one year, seven films (0.63 per cent) showed exposures above the present permissible weekly tolerance (300 mr). Of 2,740 film badges worn by technicians over the same period, three films (0.11 per cent) revealed over-exposure.

Two tables. ALFRED O. MILLER, M.D.
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Pseudotuberculoid Reaction Following Irradiation of the Skin. B. B. Milstein. Brit. J. Surg. **39**: 520–521, May 1952.

The author reports a case of pseudotuberculoid reaction of the skin following irradiation for a basal-cell carcinoma. The patient had had a cancer near the left nasal fold four years previously which had been treated by interstitial radium insertion. The rodent ulcer healed, but six months before admission the patient noticed lumps developing in the skin at the sites of insertion of the needles. These lumps were treated by wide excision and plastic repair, and after two years there was no sign of recurrence. Microscopic examination of the skin nodules showed in addition to the usual irradiation changes, many pseudotubercles in the subcutaneous tissue and muscle. These pseudotubercles were examined for acid-fast bacilli, but none were found. Examination of the sections by polarized light showed the presence of scattered doubly refractile particles, some within the tubercles and some in the subcutaneous tissue with no reaction about them. A few of these doubly refractile granules were found within giant cells.

The author reviews reports of similar reactions described by others and also reports of classical talc granulomas. The similarity between these lesions is discussed. It is suggested that the pseudotuberculoid reaction following interstitial irradiation is due not to the irradiation but to a talc granuloma which results from small quantities of talc on the radium needles inserted into the skin.

Four photomicrographs. SIDNEY KING, M.D.
Hancock, Mich.

Serum and Urinary Fibrinolytic Activity Related to the Hemorrhagic Diathesis in Irradiated Dogs. J. Colgan, E. Gates, and L. L. Miller. J. Exper. Med. **95**: 531–542, June 1, 1952.

The urine and serum fibrinolytic activity were measured in dogs following whole-body irradiation ranging from 450 to 800 r. The physical factors were as follows: (1) 1,000 kv.p., 3 ma., 8.2 to 8.4 r per minute, half-value layer 6 mm. lead; lead parabolic filter making a uniform field; target-skin distance 87.5 cm. (2) 250 kv.p., 15 ma., 9.1 to 9.2 r per minute, half-value layer 2.5 mm. copper; aluminum parabolic filter + 0.5 mm. copper, making a uniform field; target-skin distance 90 cm. Five dogs were irradiated at 250 kv.p., and 6 at 1,000 kv.p.

The fibrinolytic activity of the urine showed a precipitate rise four to five days before death in all dogs with pulmonary hemorrhage as the main cause of death. The fibrinolytic activity of the serum showed a similar rise, which was most pronounced in the case of those animals which did not survive. In all the surviving dogs, the fibrinolytic activities of the urine and serum approached control levels at about the twenty-fourth day after irradiation.

Since the mode of activation of the fibrinolytic enzyme varies from species to species, further investigation is required. If the authors' observations on the dog are found to hold true in man, then the extent of serum proplasmin activation and its subsequent appearance in the urine as a lytic agent could be used as an index of the extent of radiation injury and as a possible prognostic aid.

If one is able to anticipate the course of the various stages of the hemorrhagic syndrome by measurement of the urine and serum fibrinolytic activity, certain procedures for the treatment of radiation injury naturally suggest themselves. The attack could be made from the following points of view (*a*) inhibition or inactivation of the tissue kinase, which is capable of converting the inert substrate proplasmin into active plasmin, (*b*) inhibition of the active plasmin. If the postulates of Astrup (Biochem. J. **50**: 5, 1951) are confirmed, the blocking substance itself could be used to inactivate the fibrinokinase. Failing this, other inhibitory substances might be found. The second of the possibilities just mentioned derives from the fact that there is a known plasmin inhibitor normally present in the circulating blood stream. If large quantities of this antiplasmin or a proteolytic enzyme inhibitor of a similar nature were injected, then any circulating plasmin might be complexed with the result that clot dissolution and resulting hemorrhage could be kept at a minimum.

Four graphs; 3 tables.